JUL 6 1921

VOL. LXXXVIII. No. 2273. | JUNE 17, 1921. | PRICE SIXPENCE.

LONDON: PUBLISHING OFFICE, 4, LUDGATE HILL, E.C. 4. SUBSCRIPTION RATES, Postage Free: United Kingdom, £1 14s. 6d.; Canada, £1 12s. 6d.; Colonial and Foreign, £2 1s. 6d. per annum.—NEW YORK: D. VAN NOSTRAND CO., 25, Park Place, New York City. TORONTO, ONT.: WM. DAWSON & SONS, LTD., Manning Chambers. PARIS: BOYVEAU & CHEVILLET, Librairie, Etrangère, 22, Rue de la Banque.
Telegraphic Address: "Ageekay, Cent., London." A B C. Code. Telephone Nos.: City 997; Central 4425.

All Rights Reserved.

Registered at G.P.O. as a Newspaper and Canadian Magazine rate of Postage.

LITHOLITE INSULATORS, Ltd.
65—57, Hackney Grove, London, E. 8.
Phone and Telegrams: Dalston, 692, London.
FIREPROOF AND OTHER GRADES.
ESTABLISHED NEARLY 20 YEARS.

Birkby's **"ELO"**
For all purposes for which moulded insulation is required specify "ELO"—which is water, oil and heatproof.
FLEMING, BIRKBY & GOODALL, LTD.
LIVERSEDGE, YORKSHIRE.

WRIGHT 'Phone: 499 Tel.: Motor.
A.C. and D.C. **MOTORS.**
WRIGHT MOTORS, Ltd., HALIFAX.

EVERY DESCRIPTION OF
SMALL TURNED PARTS and CASTINGS for ELECTRICAL ENGINEERS.
A. MORTON,
6, Tenby Street North, Birmingham.

BROOK
ONE, TWO and THREE-PHASE
MOTORS.
See Sup. 39.

SWITCHGEAR.
ERNEST F. MOY, LTD.,
Manufacturing Electrical Engineers and Government Contractors.
GREENLAND PLACE, CAMDEN TOWN, LONDON.

MICA & MICANITE
TAYLOR & PETTERS, LTD.,
40, Hatton Garden, London, E.C. 1.
'Phone: 4575 Central. See page ii.

MOTORS. • DYNAMOS.
VICTORIA DYNAMO & MOTOR CO.,
CRAVEN HOUSE,
Kingsway, London, W.C. 2.
'Phone: Gerrard 1345.

CHURTON
SINGLE and POLYPHASE
MOTORS.
T. HARDING CHURTON & CO., LTD.,
Atlas Works, Water Lane, LEEDS.

ELECTRIC MOTOR REPAIRS.
ARMATURES REWOUND.
H. DUNN & SON,
Newington Causeway,
Tel.: Hop. 1167. LONDON. S.E. 1

"EMPIRE"
AUTOMATIC CONTROL
FOR
Pumps, Compressors, Machine Tools.
ELECTRIC CONTROL, LIMITED, GLASGOW.

WESTERN-ELECTRIC
COMPANY, LIMITED,
Norfolk House, Victoria Embankment, W.C. 2
Works: NORTH WOOLWICH, LONDON, E.
TELEPHONES & CABLES.
See Advertisement last week, page xxxiv.

CONNOLLY'S (BLACKLEY), Ltd.
for
WIRES AND CABLES.
See Advertisement this week, p. iii.

WHITE
Electrical Instrument Co., Ltd.
2, 4 & 6, GLOUCESTER ST.,
CLERKENWELL, LONDON, E.C. 1.
Wire Voltograph, London. 'Phone: City, 8660.

ELECTRIC MOTORS.
One, Two and Three-Phase.
BRITTAIN'S ELECTRIC MOTOR Co.
(Late Langdon-Davies Electric Motor Co.),
110, Cannon Street, London, E.C. 4.

INSULATING -- BEADS --
Immediate Delivery.
HOLDER-HARRIDEN LTD., 35/37, Noble St., London, E.C.

Victorian Railways Electrification.
See Sup. 12.

For Air Pumps, Condensers, Circulating Pumps.
VALVES.
DERMATINE
DERMATINE CO., Ltd.,
Neate St., London, S.E.5

SHUNT REGULATORS.
MOTOR STARTERS and all classes of Resistance Work.
REPAIRS TO ANY MAKE. **MOTOR STARTERS.**
THE SOLENOID REGULATOR CO.,
HIGHGATE SQUARE, CAMP MILL.
Telephone: Midland 668 **BIRMINGHAM,** Telegrams: Solenoid, Birmingham.

MAVOR & COULSON, Ltd.,
GLASGOW.
MOTORS, DYNAMOS, SWITCHGEAR.

A 1650-ft. SPAN
using
Conductors of ALUMINIUM
SEE SUP. 5.
British Aluminium Co., Ltd., 100, Queen Victoria St., London.

RAYNER & HEALD, LTD.,
DUKE STREET, DERBY.
TWO & THREE-PHASE MOTORS only.

FULLER'S UNITED ELECTRIC WORKS, LIMITED.
MANUFACTURERS OF
ACCUMULATORS BATTERIES
WIRES & CABLES CARBONS, &c.
WORKS: CHADWELL HEATH, ESSEX.
General Sales Offices:
IDDESLEIGH HOUSE, Caxton St., Westminster.
Grams: Bisebas Vic. London. *'Phone: Victoria 6363.*

INGLEBY & CO.,
ELLAND ROAD, LTD.
MOTORS LEEDS.
FOR DIRECT AND ALTERNATING CURRENT
Tel. 372.
Delivery from Stock up to 50 H.P.

Advertisement Index, see page xxxvi.

SWITCH ON EDISWAN

For any of the following Electrical Supplies:—

Accessories.
Accumulators.
Bells & Accessories.
Circuit Breakers.
Controllers.
Decorative Fixtures.
Decorative Glass Ware.
Dry Cells.
Dynamos.
Electric Fires and Radiators.
Fans and Ventilators.
Heating and Cooking Appliances.
Industrial Fittings.
Inert Cells.
Instruments—Indicators.
Instruments—Meters.
Ironclad Switch Gear.
Lamps—Royal Ediswan gas-filled & vacuum types.
Leclanche Cells.
"Little Glutton" Vacuum Cleaner.
Motors.
Oil Switches,
Telephones & Accessories.
Wires and Cables.

Mark the items in which you are interested and post this page to us, when we will gladly supply full information.

THE EDISON SWAN ELECTRIC CO., LTD.,
PONDERS END, MIDDLESEX.
London Showrooms:
123-5, Queen Victoria St., E.C. 4 & 71, Victoria St., S.W.1

WRITE FOR

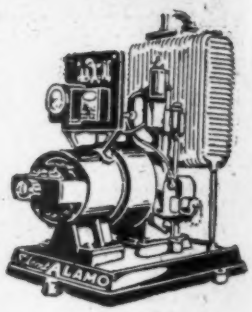
TRADE TERMS

OF THE

***Silent* ALAMO**

ELECTRIC LIGHT PLANT.

THE
"ROLLS-ROYCE"
OF
ELECTRIC LIGHT
PLANTS.



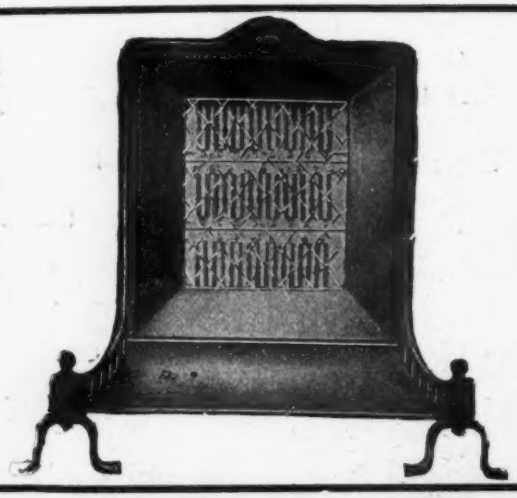
ENQUIRIES INVITED FOR THE APPOINTMENT OF SELLING AGENTS.

ALAMO ELECTRIC Ltd.,
36, Grosvenor Gardens,
'Phone: Vic. 9060. **LONDON, S.W.**

MICA & MICANITE

INSULATORS FOR EVERY DESCRIPTION OF ELECTRICAL WORK.
Contractors for Air Board, War Office and Admiralty Requirements.
CUTTING AND GAUGING OUR SPECIALITY.
BEST QUALITY MICA ONLY.

'PHONE—4575 CENTRAL.
TELEGRAMS—"MICAYLOR, LONDON."
TAYLOR & PETTERS, LTD.,
40, HATTON GARDEN,
LONDON, E.C.1.
(The Oldest Established Mica House in the country.)
AND ALL BRITISH.



THE
ARORA ELECTRIC FIRE

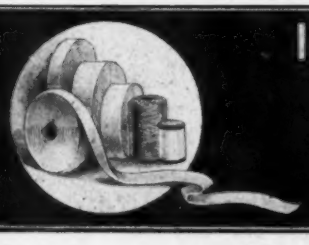
Has given universal satisfaction.

WHY? Because OUR patented Element is of HEAVY SECTION and has LOW Current Density, yet it glows at a HIGH TEMPERATURE.

Low Price, Robust, Cheery, Economical.

Write for List E (Fires & Cookers) to Sole Manufacturers:

THE ARORA CO., Loughborough.
(Proprietors: MESSENGER & CO., LTD.)



INSULATING MATERIALS - *Delivery from Stock*
SUPERFINE COTTON, LINEN & SILK TAPES.
DYNAMO TAPES, FIELD COIL WEBBING, CABLE TAPES.
ADHESIVE TAPE, TUBULAR SLEEVING, ARMATURE BINDING CORDS &c.
JOHN MACLENNAN & Co
115 NEWGATE STREET LONDON E.C.1.
Telephone - City 3115
And at GLASGOW

s

IT.

d.,

v.

THE

ELECTRICAL REVIEW.

VOL. LXXXVIII. JUNE 17, 1921. No. 2,273.

ELECTRICAL REVIEW.

Vol. LXXXVIII.] CONTENTS: June 17, 1921. [No. 2,273

	Page
The Industrial Outlook	769
Lighting Authorities and Actions for Negligence	770
The Electrification of Railways	770
The Relationship between Efficiency and Working Costs of Small Motors and Generators, by E. G. Kennard (*illus.*)	771
An Agreement to Serve Abroad—Its Legal Aspect	773
New Electrical Devices, Fittings and Plant (*illus.*)	775
Exports and Imports of Electrical Goods for May, 1921	776
The "Glo-Clad" Wiring System (*illus.*)	776
Electric Development in Jamaica	777
Legal	777
Correspondence—	
Electric Light Wiring Systems	777
Fire Prevention and the Insurance Companies	778
Kinema Supply	778
Wear of Rotary Converter Slip Rings	778
The Lubrication of Ball Bearings	779
"Though One Rose from the Dead"	779
The Grading of Mains Engineers	779
Business Notes	779
Notes	785
City Notes	789
Stocks and Shares	791
Market Quotations	792
The Failure of Metals under Internal and Prolonged Strain	793
Recent Developments in Turbine Practice	794
Joint Electricity Authorities	796
Reviews	799
New Patents Applied for, 1921	800
Abstracts of Published Specifications	800
Contractors' Column	Advertisement page xxvi

"ELECTRICAL REVIEW" SUBSCRIPTION RATES.

UNITED KINGDOM	£1 14 8 per annum.
CANADA	1 12 6 do.
COLONIAL and FOREIGN	2 1 6 do.

Postage Free.

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 6d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE, 4, LUDGATE HILL, LONDON, E.C. 4.

Telegraphic Address: "AGEKRAY, CENT., LONDON." Code, A B C.
Telephone Nos.: City 997 Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson & Co., Gresham Street.
AUCKLAND N.Z.: Gordon & Gotch, Albert Street; Peter G. Tait, P.O. Box 392.
BRISBANE: Gordon & Gotch, Queen St.
CHRISTCHURCH, N.Z.: Gordon and Gotch, Manchester Street.
DUNEDIN, N.Z.: Gordon & Gotch, Princes Street.
JOHANNESBURG, CAPETOWN, BLOEMFONTEIN, DURBAN, PORT ELIZABETH, &c. Central News Agency, Ltd.
LAUNCESTON: Gordon & Gotch, Cimitiere Street.
MELBOURNE: Peter G. Tait, 90, William Street; Gordon & Gotch, Queen Street.
MILAN: Fratelli Treves.
NEW YORK: D. Van Nostrand, 25, Park Place.
PARIS: Boyveau & Chevillet, 22, Rue de la Banque.
PERTH, W.A.: Gordon & Gotch, William Street.
ROME: Loescher & Co., Corso Umberto 1° 307.
SYDNEY: Peter G. Tait, 273, George Street; Gordon & Gotch, Pitt Street.
TOKYO: Maruzen Co., Ltd., 11-16, Nihonbashi-Tori-Sanchome.
TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.
WELLINGTON, N.Z.: Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, LIMITED, and crossed "London City and Midland Bank, Newgate Street Branch."

THE INDUSTRIAL OUTLOOK.

THE great question occupying the minds of employers and workers at the present time is that of wage reductions. It is probably true to say that everyone realises that wages must fall, and the points for consideration are: By how much, and in what steps?

By the time these words are before our readers it is possible that the engineering industry will be at a complete standstill. It is doubtful whether the coal strike will be settled, and practically certain that the cotton trade will still be idle. The iron and steel industry has been almost entirely stopped, as a consequence of the coal trouble, since the beginning of April.

The cotton trade represents approximately one-third of our national exports. The world, as Sir Robert Hadfield has told us, is hungry for steel. It is also hungry for British coal and engineering products. We are exporting none of these things, but we are buying foreign coal, and burning imported oil under our boilers wherever it is possible—perhaps "necessary" would be a more applicable word—to do so. Short of actual violence and civil tumult, our greatest enemy could not wish to see the country in worse plight; but, apart from Ireland, the complete calm, almost amounting to apathy, of the public, is perhaps one of the most remarkable features of the situation.

It is, unfortunately, only too true that there is a serious depression in trade. Orders are scarce, and competition, for what business is available, is exceedingly keen. Yet we know that many of the large firms, particularly in our own industry, have well-filled order books; it has, indeed, been an outstanding feature of speeches at shareholders' meetings for the statement to be made that the factory can be kept going for a considerable time. Firms in this position cannot, and we believe it is safe to say they do not, want a stoppage; and when, as we have shown over and over again, output, production, plenty of everything, is the crying need of the time, it is clear that it is not in the interests of the nation or of the world at large that three of our leading industries, with numberless secondary trades, should be shut down. The workers themselves would, of course, rather be at work earning money than be idle.

Who, then, is in favour of closing down? Obviously it can only be such firms as have not enough work in hand to keep going, and those whose standing charges are so small that it is of little moment whether they keep open during the slump or not. English folk are very individualistic, and there are many small business concerns in existence which must feel the present condition of things very keenly.

When overhead charges are small, direct wages are apt to loom larger in the mental landscape than is warranted by their actual importance. Direct wages form but one of the constituent factors of the price of the finished product. In some classes of electrical apparatus direct wages amount to from 16 to 20 per cent. of the works cost when the goods are made in a large works. The rest of the cost consists of material and of overhead charges in the factory. The commercial charges and profits have then to be added, so that the proportion of the whole selling price represented by direct wages becomes still less. In a smaller concern, overhead factory charges and commercial expenses are both relatively and absolutely smaller, and the direct-wage proportion is relatively greater, both for this reason and also for the reason that the small concern

will not infrequently do most of its business by underselling its larger competitor.

We can now see a reason which might impel a small firm to make drastic cuts in wages; and in employers' conferences the small firms are in the majority, so that their votes can carry the issue. So we find that, in spite of a reserve of orders which can be drawn upon, like a banking account, to tide over the evil day, there is a danger that by excessive reductions of wages, resulting in strikes, we shall proceed to kill export business by increasing the period required for delivery, and deliberately force the trade of the world into the hands of those who are ready, and willing, to work for it.

The industrial situation is comparable with the military situation as it existed in the spring of 1918. The enemy is not labour, but bad trade, and we shall defeat that enemy by co-operation, team work, and goodwill. These granted, the needs of the world will provide plenty of work, and it will be found that the workers' standard of living can be maintained at a level considerably better than before the war. We repeat that labour is not the enemy, and consequently it is wrong to talk of "the conflict with labour." Talk of that kind does no good, but only exacerbates tempers on both sides.

In this connection the remarks of Mr. Robert Fleming at the meeting of the Investment Trust Corporation last week are worthy of quotation: "To-day the great bulk of the cost of everything we buy consists of wages, so that any general fall in wages must necessarily bring down with it the cost of living. Thus no real reduction in the standard of living need take place if that standard is not wasteful, but carefully economical. . . But even lower wages and greater production are not enough unless combined with the highest efficiency from the capital and managerial end."

Why is not more use made of the Industrial Courts? They were hailed with acclamation as a statesmanlike provision for the settlement of industrial differences, but the dockers' dispute remains almost the only example of the reference of such a dispute to such a Court. It ought not to be necessary for ministers—even the Prime Minister—to take a hand in such matters. It may be necessary in the case of coal, because coal has been under Government control, and the Government has offered £10,000,000 for the purpose of letting wages down with rather less of a bump than the owners appear to find necessary. It almost seems as if this is another of the cases in which excellent machinery has been provided, but, through some error of judgment, remains unused. Surely, even if coal cannot be referred to an Industrial Court, the cotton and engineering disputes can be.

The suggestion is not new, and we hope it may bear fruit speedily, for assuredly the continuance of the present condition of things is a grave national disaster.

Lighting Authorities and Actions for Negligence.

A case which was heard in the Court of Appeal recently (Sheppard *v.* Mayor of Glossop, Elec. Rev., April 15th, 1921, at p. 479, and *Law Journal*, April 23rd, at p. 160) raised a point which is of considerable importance to lighting authorities—especially in view of the fact that, on account of the coal trouble, restricted lighting has become necessary. The facts of the case having been fully reported in our pages, we may limit our reference thereto by stating that the plaintiff brought the action, claiming damages for personal injuries owing to the negligence of the defendants in not lighting a certain gas lamp.

Mr. Justice Greer held that the effective cause of the plaintiff's losing his way and falling over the retaining wall was the turning-off of the light in the lamp, that the defendants were the lighting authority of the district under Section 161 of the Public Health Act, 1875, and that, by causing the lamp to be extinguished, they caused the place to become a dangerous trap into which the plaintiff fell; and the learned judge awarded him £279 10s. damages. The defendants appealed. Section 161 of the Public Health Act provides that an urban authority may (*inter alia*) provide lamps and other apparatus for lighting the streets within their district and also gas for such purposes throughout the whole or any part of their district.

The Court allowed the appeal, holding that the effect of the section was to give the defendants authority to light their district, but it created no obligation to light it, and gave them a discretion as to whether they would light only some portions of their district; *and it also gave them full discretion as to when the lamps were to be kept lighted in any portion of the district which they elected to light.*

It is all-important to observe that the above decision was based upon the Public Health Act, 1875. It does not follow that local authorities in all parts of the country can be excused in the like circumstances, because in some places an obligation to light—as opposed to a power to light—is imposed upon the authority. Thus in Carpenter *v.* Finsbury Borough Council ((1920) 2 K.B. 195) Sec. 130 of the Metropolis Local Management Act has to be considered. By that section: "Every (local authority) shall cause the several streets . . . in their district to be well and sufficiently lighted and for that purpose shall maintain or set up and maintain a sufficient number of lamps in every such street and shall cause the same to be lighted with gas or otherwise and to continue lighting at and during such times as such vestry or board may think fit necessary or proper. . . ." It was held under this section that the obligation of the local authority as to any particular street is to ensure that it is well and sufficiently lighted. Where an accident is alleged to have been due to the insufficient light provided in a street it is for the tribunal of fact to determine whether the statutory obligation of the local authority has been complied with; it is not enough for the local authority to say that in their discretion they considered that the lighting actually provided was sufficient. It will, therefore, be seen that the Glossop case has no application in the metropolis. It is important, too, to observe that in coming to the conclusion at which it arrived the Court of Appeal overruled the finding of Mr. Justice Greer that the plaintiff had been lured to destruction by a trap, *i.e.*, the sudden and unexpected extinguishment of the light. In this respect two important previous decisions appear to be overruled; but notwithstanding the ruling of the Court of Appeal, it is clearly desirable for any lighting authority to give due warning to the public if electric or other lamps have to be extinguished in a public place.

The Electrification of Railways.

In a recent issue we drew attention to the divergence of opinion manifested in different countries with regard to the type of current selected for the electrification of railways. We are indebted to Prof. S. Parker Smith for further information, published in this issue, which emphasises the fact that agreement on this subject is very far from attainment. Broadly speaking, we may say that the English-speaking nations favour the use of direct current, and that, except where their influence holds sway, as in the Argentine, and in France, all other countries are adopting alternating current, mainly single-phase.

The situation demands very serious consideration; if we confine our attention to the direct-current system, we run the risk of being cut off from the vast market for electric railway plant that we may confidently expect to see developing in foreign countries, unless we are in a position to prove that d.c. is better than a.c. for this purpose. Much depends upon the development of the mercury-vapour rectifier and the thermionic type of rectifier; when these are capable of dealing with the heavy railway loads with certainty, the case for the d.c. system will be materially improved, but that time has not arrived, and it behoves us to be prepared to carry out railway electrifications on the largest scale with single-phase current if the need arises.

THE RELATIONSHIP BETWEEN EFFICIENCY AND WORKING COSTS OF SMALL MOTORS AND GENERATORS.

By E. G. KENNARD, A.M.I.E.E.

The extent to which differences in efficiency exist in dynamos and motors, of similar rating, obtainable at the present day may not be generally recognised amongst engineers.

It will be found, however, that where tests of different makes of machines are compared, very considerable differences in the efficiency values exist, depending on the design, type, and material employed in the manufacture, and the purpose of this article is to draw attention to the extent to which the variation of commercial efficiency may affect the working costs of electrical machinery as seen from the small consumer's point of view.

Some important changes have taken place since the year 1914, which affect very considerably the question of rating and efficiency of electrical machinery, viz. (*a*) considerable increases in the cost of electrical energy; (*b*) revision of the rules (for electrical machinery) of the British Engineering Standards Association, Specification No. 72 (1917).

With regard to the former item, a table showing the difference between pre-war and post-war prices for electrical energy was published by the Electrical Review (June 13th, 1919), representing 240 supply undertakings in the British Isles.

Many of the prices quoted are for two-rate and sliding-scale systems, and are therefore unsuitable for the purpose of comparison, except in a general sense.

Some 63 undertakings, however, quote flat-rate systems of charging, and these values have been analysed, giving the following results:—

Average Prices of Electricity for Power in the United Kingdom in Pence per Unit.

Place.	No. of undertakings.	1914.	1919.	1921.
London	11	1·13d.	2·0d.	2·3d.
Provincial towns ...	52	1·71d.	2·65d.	3·05d.
London & provinces (average)	63	1·63d.	2·55d.	2·94d.

Since the publication of this table a further increase in the price of energy has been general. This is shown in column 4 above at 15 per cent. above the 1919 values. For present-day values the average cost per kWh for power may be taken at 2·94d., or, say, 3d. per unit.

It should be borne in mind, however, that these figures are based only on some 26 per cent. of the total number of returns published by the Electrical Review, and that if it were possible to form an average for the sliding-scale systems, the value would be somewhat lower. This mean value of 3d. per kWh will, nevertheless, be of use as a basis for cost calculations, as over 60 per cent. of the prices quoted for power at flat rates fall within 20 per cent. of this figure. It is interesting to note that the maximum and minimum flat-rate prices for power were 6·5d. in the Ogmore Valley district, and 0·873d. in the Manchester district.

Two important changes in the Specification of the Engineering Standards Association, No. 72 (1917), have been noted which materially affect the question of rating for electrical machines, and, consequently, have an important bearing on the subject in hand.

First (paragraph 46 and relative table), the temperature rise limit after the maximum temperature has been attained is now fixed at 55° C. for a.c. windings in slots, and 50° C. for rotating armatures with commutators, corresponding to temperature rises of 99° F. and 90° F., where only 70° F. was allowed formerly.

Secondly, as regards overload, whereas formerly a 25 per cent. overload test was required for one hour, the new specification (paragraph 79) allows for a 50 per cent. excess current test for 15 seconds only. Obviously, if these altered conditions of rating are strictly adhered to, a wide departure will be made in the electrical properties of modern machines compared with those designed to meet the requirements of previous specifications.

An important feature is the certainty of obtaining the maximum efficiency at 75 per cent. of the full rated load of the machine, a condition which (transformers excluded) was rarely obtainable, and, in fact, with many machines of low temperature rise the maximum efficiency was not attained until 25 per cent. overload was reached.

The curves in fig. 1 illustrate the difference in efficiency values for a 5-kW d.c. machine having its maximum values at ¾ and 1¼ of the full rated load.

The advantage of the more highly rated machine is clearly apparent for any class of work where varying loads are experienced, and, in addition, lower no-load losses are obtained.

Before proceeding with the study of working costs of various types of machines, it is desirable to have some reliable information concerning the maximum efficiency it is possible to reach commercially, and what special means to employ to obtain it. With this object in view, the writer

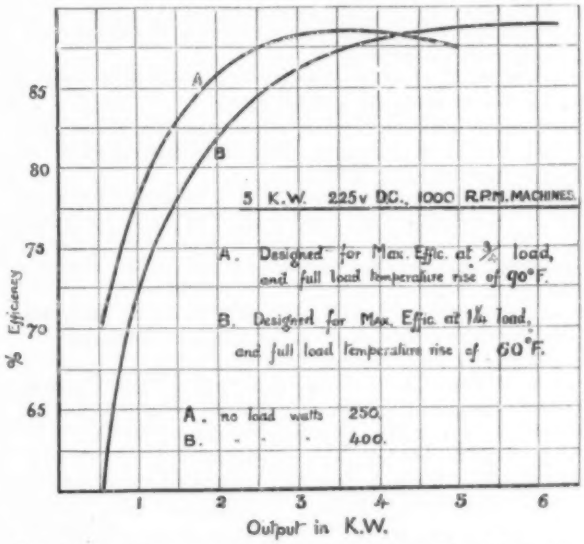


Fig. 1.—Illustrating the Difference Between Two Machines with Maximum Efficiency at ¾ Load and 1¼ Load Respectively.

has prepared a number of designs to a standardised plan, employing most recent methods, and using as a basis for calculation the constants derived from tests of the best materials obtainable commercially.

Direct-current machines have been considered, as it is possible to predetermine their performance with greater accuracy than with alternating-current machines, also the same machines are serviceable both as dynamos and as motors.

To commence with, a terminal pressure of 225 volts has been chosen, and it will be seen to represent a fair compromise between the limits of high and low-voltage d.c. circuits. With low-voltage machines the commutator losses are higher than with high-voltage machines; this difference is offset by reduced copper losses owing to a higher "space factor" in the armature slots and field coils being obtained.

Groups of designs have been prepared for machines ranging from 0·1 kW up to 10·0 kW at rated speeds of 500, 1,000, and 2,000 r.p.m. respectively, and for two and four-pole machines. Interpoles have not been included in the designs. Generally speaking, the efficiency of a machine is slightly reduced when interpoles are employed, and these calculations have been made on the basis of low armature reactance voltage (not exceeding 2 volts per segment); the commutation would, therefore, be quite good without having to make use of interpoles.

In order to obtain consistent results when preparing a line of designs, it is necessary to adhere as far as possible to certain predetermined values for such factors as the

current density in copper, flux densities in teeth, cores, magnets, &c.; in the following table the values chosen for this particular investigation are indicated, and also the limits which it is customary to employ in the preparation of designs by various makers :—

TABLE I.

—	Values employed in this article.	Limits found in standard practice.
Ratio of arm. diam. to core length. 2 pole ...	·78*	2 pole, ·5 to 1·1
Ratio of arm. diam. to core length. 4 pole ...	·39*	4 „ ·3 to ·55
Mag. density in arm. core	10—14 kilolines	4—12 kilolines
„ „ „ teeth	21—22 „	18—22 „
„ „ air gap	6·0—7·0 „	3·0—7·5 „
„ „ mag. core	15·0 „	5·0—16 „
Thickness of slot insulation	1·0 mm.	·8—1·6 mm.
Slots per cm. of periphery	·7	·4— ·9
Comm. segs., per slot ...	3	1 —5
Field spool current density	1·5 per sq. mm.	1·2—4·0 per sq. mm.
Current density in brushes	8·0	3·0—9·0 per sq. cm.
Brush pressure per sq. cm.	·1 kg.	·1— ·3 kg.
Style of winding ...	2 circuit single	various

* These values ensure a round or square section for the magnet core.

The main factors when designing for high efficiency are : First, *choice of materials.*

Iron cores when subjected to reversals of magnetism should be of Stalloy or similar brands.

Magnet cores and yokes for direct-current excitation should be of wrought iron or soft mild steel sheet of the highest permeability obtainable.

All copper conductors should be in accordance with the values specified in the Engineering Standard Specification No. 7. Insulating material should be of superior mechanical strength, heat-resisting properties, and high disruptive strength.

Carbon brushes should have self-lubricating properties, and be capable of being run at high current densities.

Secondly, *technical considerations.*

It is essential to obtain high "space factor" in all current-carrying coils, and as this value is the ratio—

$$\frac{\text{Area of copper conductors}}{\text{Area of winding space}}$$

a high space factor is dependent on the following points :—

(*a*) Minimum thicknesses of insulating material (consistent with safe working) employed for covering conductors, spool windings, and slot linings.

(*b*) Extreme care in winding all coils and solenoids so that all turns lie close together and wires do not cross.

(*c*) All winding spaces to be completely filled up.

Commutator losses may be kept low by employing brushes of high current density, and a fairly low brush pressure not exceeding 0·15 kg. per sq. cm.

Ball bearings should be used where possible, as a smaller air gap may then be employed.

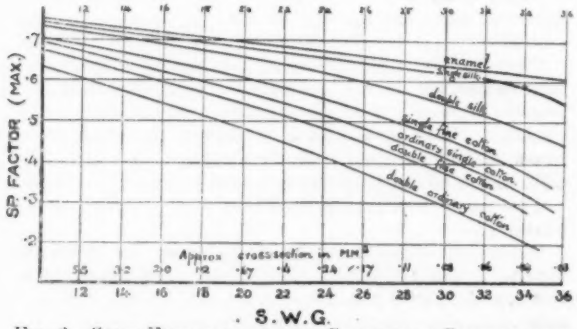


FIG. 2.—SPACE FACTORS FOR ROUND CONDUCTORS COVERED WITH DIFFERENT INSULATING MATERIALS.

A set of curves showing the space factor values for round wires employing various kinds of insulation is shown in fig. 2. It is apparent from the study of these curves that a large improvement in coil design is possible where enamel or silk-covered wires are used in place of the double cotton-covered wires at one time in general use. To take one example, a No. 20 S.W.G. enamel-covered wire has a space factor of 0·7; taking the copper cross section at ·66 sq. mm., the area occupied by the insulated wire would be ·92 sq. mm. Now a No. 22 S.W.G. wire insulated with double cotton, and having a space factor of ·45, would also occupy approximately an area of ·9 for the insulated wire, so that by substituting an enamel-covered wire for a double-cotton-covered wire, the area of copper could be increased by 63 per cent., thus allowing a current 1·28 times as great to be used for the same I^2R loss and representing a gain both in output and efficiency.

The usual practice in machine design is to proportion the armature dimensions according to the required output. In this investigation a somewhat different procedure has been adopted, the plan being to commence with an armature of fixed dimensions, and from these, to work out the rating so as to occur at the point of maximum efficiency. This has been done for a number of different sizes, and curves plotted from the points so obtained give the output in kilowatts in terms of the armature cubical dimensions.

At this stage an example of a worked design will illustrate how the values for the above curves were obtained.

Selecting a machine for 225 volts, 1,000 r.p.m., 2 poles, and having the dimensions (armature diameter)^2 × (armature gross length), or $D^2 L_g$ in cm. = 1,500, it is required to find the electrical output corresponding to the highest efficiency.

As the point of maximum efficiency occurs when the variable or I^2R losses are equal in value to the constant losses, it follows that—given a machine of certain dimensions—the lower the value of the constant losses, the higher will be the maximum efficiency; therefore iron, shunt, and friction losses must be kept as low as possible.

Given $D^2 L_g$ as 1,500, then $D = 3\sqrt[3]{1{,}500/{\cdot}78} = 12{\cdot}4$ cm., and L_g the gross length = 9·8 cm., these being suitable values for obtaining magnet cores of round section.

Magnet core area = $9{\cdot}8^2 \times {\cdot}785 = 76$ cm.^{2}

Taking "B" at 15·0 kilolines and allowing 20 per cent. for magnetic leakage, a flux of 0·94 megaline through the armature is obtained.

Estimating by the ordinary routine method, the field ampere turns required to overcome the reluctance of the magnetic circuit, the value 1,680 is obtained (per pole).

For calculating the copper losses in shunt and armature coils, the following formula may often conveniently be employed.

I^2R loss = weight in kg. × d^2 × K, where d = current density in amperes per sq. mm., and K a factor depending on the temperature at which the winding will operate (at 60° C., K = 2·25).

At a current density of 1·5 amperes per mm.^{2} the total copper area in the shunt coil will be 1,680 ats./1·5 × 100 = 11·2 sq. cm., and taking the mean length of a turn as 40 cm., the total weight of copper per spool = 4·0 kg.

Watts lost per spool are $4{\cdot}0 \times 1{\cdot}5^2 \times 2{\cdot}25 = 20{\cdot}5$.

It has been established experimentally by different authorities that the core losses in revolving armatures are fairly proportional at ordinary working values for the relation "watts per kilogram" in terms of "flux density" × "cycles per second" where the latter product does not exceed a value of 360, but when this value is exceeded the losses increase to a greater extent.

Then building the armature from best quality low loss materials the economical flux density can be estimated so as to give "K" approximately 360, provided a density of 14·0 kilolines is not exceeded, increased reluctance then being the limiting factor.

Using Stalloy iron at B = 14·0 kilolines, and at a frequency f of 16·6 cycles, the iron loss amounts to 21 watts.

Adding 22 watts to include windage, bearing, and brush friction losses, and 41 for total shunt loss, a total of 84 watts for the constant losses is obtained.

The next step is to proportion the armature windings to suit the required voltage and speed, and to determine the loading in amperes that will correspond to an I^2R loss of 84 watts.

Number of armature conds. = $(V - IR) \times 10^2/f \times$ flux in megalines

= 21,000/16·66 × ·94 = 1,344, with 28 slots = 48 per slot.

Estimating the maximum area of the slot to conform with the uncorrected tooth density of 22·0 kilolines, ·98 cm.² per slot is obtained, and arranging the conductors 12 deep × 4 wide, a depth of 15 mm. and width of 6·5 mm.

Employing a slot lining 1 mm. in thickness, a space factor of ·365 can be obtained, allowing a wire of ·98 mm. diam. and ·74 mm.² section to be used.

Estimating the average length of one armature turn to be 68 cm., a total weight of 3·0 kg. of copper is obtained.

Then amps. per mm.² per arm. cond.

$$= \sqrt{\text{Watts/kg.} \times 2{\cdot}25} = \sqrt{84/3{\cdot}0 \times 2{\cdot}25} = 3{\cdot}52.$$

$$\text{Total armature current} = 3{\cdot}52 \times {\cdot}74 \times 2 = 5{\cdot}2.$$

Watts input to armature at 225 volts	= 1,170
Total losses, excluding shunt winding	= 127
Armature output at maximum efficiency	= 1,043
Total input to motor (including shunt)	= 1,211
Maximum efficiency	= 86 %

With three segments per slot, and eight turns per segment, the reactance voltage, as calculated by Hobart's formula, is approximately 1·3 volts; a much greater load could, therefore, be carried without sparking at the brushes. Calculations for temperature rise show that (where a maximum temperature of 90°C. is permitted) a full-load rating of 1·25 to 1·35, according to the rated speed, above the point for maximum efficiency may be obtained, as follows :—

Rated speed of machine.	Maximum efficiency occurs at—
500 r.p.m.	65 % of full load.
1,000 r.p.m.	72 % of full load.
2,000 r.p.m.	77 % of full load.

Thus, it is seen that the condition of maximum efficiency at ¾ load is readily obtained.

In fig. 3 the full line curves have been plotted from the results of 36 separately worked designs prepared by the writer in accordance with the foregoing method for obtaining maximum efficiency.

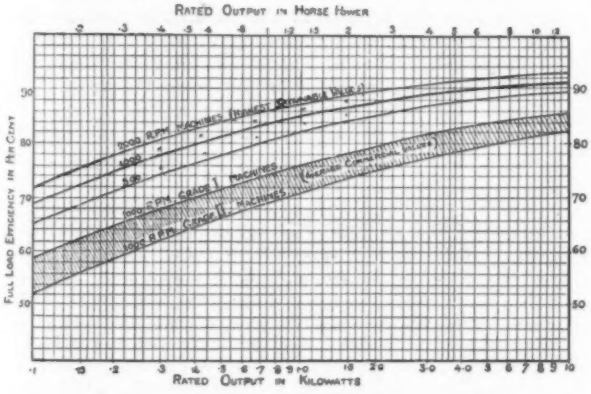


FIG. 3.—EFFICIENCIES OF D.C. MACHINES OF DIFFERENT TYPES AND VARIOUS RATED OUTPUTS AND SPEEDS.

These represent an average value between two and four-pole designs. Generally speaking, a slightly higher value is obtained when using two poles for a given rating, but an economy in weight is effected by the use of four poles; but it may be accepted that for ratings ranging from 0·1 to 10·0 kW, the difference in efficiency between two- and four-pole machines is immaterial.

The results shown graphically by the curves in fig. 3 establish the important fact that it is possible to design machines of considerably higher efficiency than is usually obtained commercially, which tends to prove that in most circumstances the first cost of the machine is the first consideration.

In support of these figures it is mentioned that a small motor built on the lines indicated and rated at 100 watts at 1,000 r.p.m. gave a maximum tested efficiency of 67 per cent., the net weight being 36 lb.; the cost for material was not excessive, but special care was taken in winding, &c. In order to emphasise the difference between what may be termed the ideal values for efficiency, and those obtainable from the majority of machines at present on the market, in fig. 3 the shaded area represents the limits of full-load efficiency, as observed in most of the machines manufactured at the present time.

The lower values (Grade II) can usually be attributed to the use of cast-iron magnetic systems in conjunction with a poor space factor in armature slots. This low value is sometimes unavoidable where very high flash volt tests are required by the purchaser.

It will also be observed from these curves that high-speed machines are more efficient than those of a low rated speed. This condition holds good up to a point where the increase in rated speed occasions a reversal of flux through the armature of not more than 60 cycles per second, corresponding to a speed of 3,600 r.p.m. for two-pole machines, and 1,800 r.p.m. for four-pole machines.

At speeds above these limits the increased losses in the armature core tend to offset any advantage that is obtained by a reduction in copper losses, also considerations of armature temperature rise may prevent working at the maximum efficiency.

(To be continued.)

AN AGREEMENT TO SERVE ABROAD—ITS LEGAL ASPECT.

(FROM A LEGAL CONTRIBUTOR.)

MANY young English electrical engineers are tempted to go abroad; to forsake the land of their birth and take up employment in some one or other of our great dependencies. Some are even lured into the service of persons or Governments in foreign countries.

The tide of this special form of emigration has been flowing very strongly since the war, and it is still flowing. The present outlook in these islands is not altogether hopeful for the young and energetic; for the man who wants to get on by his own exertions. "Better fifty years of Europe than a cycle of Cathay." So run the old lines; yes!—But they were written before everything had been turned upside down in a European conflagration.

But zeal to travel on the road to victorious fortune should be tempered with discretion. A job in the Colonies or elsewhere abroad must not be rashly accepted. The salary offered may be high and the prospects inviting, but it is necessary to scrutinise with particular care the terms upon which the services are to be rendered. To reduce an agreement to writing is at all times expedient. It is doubly necessary to do so when the parties who have entered into the arrangement are to be far apart.

Let us first briefly enumerate the points to which attention must be directed in drawing up such an agreement. The salary, when and where and how it is to be paid; who is to pay travelling and other expenses; for what period the service is to endure; whether it can be put an end to by either party, and if so, what notice is necessary; how disputes are to be settled; according to what currency remuneration is to be paid; and whether there is to be any restrictive covenant preventing the engineer practising in the same place for a stated period after the termination of the contract. All these questions have to be carefully considered.

It should be mentioned, in the first place, that a written agreement is absolutely essential in certain cases. Thus a contract of service which is not to be performed within the space of one year from the making thereof must be in writing.

So it has been decided that a contract to serve for one year, the service to commence on the second day after that on which the contract is made, is a contract not to be performed within a year (Britain *v.* Rossiter, 1879, II, Q.B.D., 128). It may be mentioned, however, that where there is a contract to serve for one year, the service to commence on the day next after

that on which the contract is made, this is not a contract which is not to be performed within a year (Smith *v.* Gold Coast and Ashanti Explorers, Ltd., 1903, I.K.B. 538).

We may assume, however, that in the ordinary case of an engineer taking an appointment at a yearly salary, without the duration of the employment being mentioned, the agreement must be in writing.

As to the salary, the time and place of payment of instalments should be specified. Where it is a lump sum payable by quarterly instalments, the instalments can be recovered as they fall due. So where a man was employed as consulting engineer for £500, payable in equal quarterly instalments for 15 months to complete certain works, and he died after two instalments had become due, but before the work was finished, his administrator was held entitled to recover the two instalments (Stubbs *v.* Holywell Railway Co., 1867, L.R. 2 Ex. 311).

All expenses other than living expenses should be provided for in the agreement. In going abroad to take up a post heavy travelling expenses will be incurred. These should be provided for by a payment in advance. If the climate is unhealthy, malaria or other diseases may add very materially to the cost of living—or trying to live. In these circumstances the question whether the salary is to continue during incapacity caused by illness is one which should certainly be settled beforehand.

Again, the expenses of travelling both out *and home* should be arranged for; care being taken to provide specially for the travelling expenses of the servant's wife. Although he may not be married at the date he signs the agreement, he may possibly find a wife before his term of service comes to an end, and he may not want to leave her behind when he comes home!

The length of notice requisite to terminate the contract is a matter which should be carefully considered before the agreement is signed, inasmuch as the position of an engineer in a foreign country who is suddenly dismissed is deplorable to a degree. He ought to insist on being given such a length of notice that it will be impossible for him to be left stranded. Service is usually determined by notice, and the question is: What notice must be given? When the hiring is a yearly hiring it cannot in general be put an end to by either party before the end of the year. If, therefore, on the one hand, a master wrongfully dismisses his servant during the year the servant may maintain an action against him for such wrongful dismissal, and a jury might assess the damages at the amount which he would have earned had he been allowed to serve to the end of the year.

A hiring at a salary of so much a year is a hiring for a year certain. So where a man was employed as engineer to the defendants at a salary of £500 a year, and was dismissed at a three months' notice, he was held entitled to recover salary for the unexpired portion of the year (Buckingham *v.* Surrey & Hants Canal Co., 1882, 46 L.T. 889).

It is clear, however, that where it is a question of foreign service, special care should be taken to provide for an adequate notice. Attempts are sometimes made by employers to obtain an option to dismiss at will. In Down *v.* Pinto, 1854, 9 Ex. 327, the defendant having established smelting works at Carthagena, in Spain, offered to employ the plaintiff as foreman, by letter, containing the following passage: "I should require you to enter into an agreement to remain with me for at least *three years at my option*. Salary £250 per annum." It was held that this did not enable the defendant to put an end to the service at his will, but that it was a yearly hiring, with an option for the defendant to require the plaintiff's services for three years, or put an end to it at the expiration of the first, second, or third year.

Care should be taken to make the right to give notice reciprocal—that is, to enable the engineer to say: "I want to go" within a certain period. This is the more important, because a yearly servant, wrongfully quitting his master's service, forfeits all claim to wages for that part of the current year during which he served, and cannot, after having wilfully violated the contract, claim the sum which his wages would have amounted to had he kept his contract.

The importance of making provision in the contract for notice to quit was emphasised in a case (Baker *v.* The African Association) which was heard on January 20th, 1910, in the King's Bench. A man was engaged to go to Calabar, on the Gold Coast, as a clerk, at a yearly salary. The agreement provided that if he failed to give satisfaction to the employers' agents, or absented himself from his duties, &c., the agent might summarily dismiss him, in which case he would have no claim for his passage home. He was under covenant not to trade within 30 miles of Calabar for two years after the termination of his employment, subject to a penalty of £100. On his returning to England he was suddenly dismissed, no reason being assigned. The clause as to the duration of the service provided as follows: "The said A. (meaning the clerk) shall, as from the date of leaving Liverpool for Africa, become and, subject as hereinafter prescribed, continue for two years, or until the date of his leaving Africa, in the service and employment of the said employers as clerk . . . at Calabar . . . provided always, however, that the employers may at any time hereafter, at their absolute discretion, terminate this engagement at any earlier date than specified if they may desire to do so." It was held that under this clause the employers had an absolute discretion to fix an earlier date for the termination of the agreement than the two years, but that the clause did not give them an absolute discretion to dismiss Baker summarily within the two years without giving him a reasonable notice.

With regard to settlement of disputes it is most desirable that the agreement should clearly indicate the law or system of laws according to which they are to be adjusted. People sometimes have a prejudice against the mere mention of the word "dispute" in an agreement; but disputes must and will occur, and when they do it is eminently satisfactory for an Englishman at least to have them adjusted according to the law of his own country.

It may be mentioned that if the employer is a foreigner there is (generally speaking) very little difficulty in getting him to accept a clause providing for the settlement of disputes in accordance with English law. It is said, indeed, that some foreigners have more confidence in English judges than they have in those who administer the law in their own countries.

Finally, there should be no room for doubt—especially in these days—as to the *currency* in which the proposed salary is to be paid. It may be said that the amount of his "screw" is the first thing an aspirant for a job abroad will inquire about; but he should have it fixed and set down in writing. *Litera scripta manet; vox audita perit.* And while on this subject a currency—if one may venture to drop a hint upon a question of general rather than legal interest—it is well to bear in mind that "rates of exchange" mean very little unless they are considered in relation to the cost of living. To hear that you are to have a salary of £2,000 a year in a country at the back of the beyond, where the exchange is said to be in your favour, may be very attractive; but the attraction begins to wear off when you arrive at the place to find that the cost of living is four times what it was in old England!

Finally, we have to consider the question of restrictive covenants. A restrictive covenant prevents a man entering into competition with his late employers after the service comes to an end. If it is unreasonable, whether as to time or space, it will not be enforced, but it is not easy to show that a covenant is unreasonable. No engineer should sign an agreement with a restrictive covenant if he can possibly avoid it. It may be mentioned, however, that it has lately been decided that a man who is wrongfully dismissed need not observe the restrictive covenant to which he was subject.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A New Printing Press Controller.

We recently had the pleasure of inspecting a new type of printing press controller at the Vauxhall Works of the Electrical Apparatus Co., Ltd., South Lambeth Road, London, S.W. 8. The gear under review, as will be seen from fig. 1, is motor operated, the firm having employed for the purpose a machine of the standard type as fitted in its

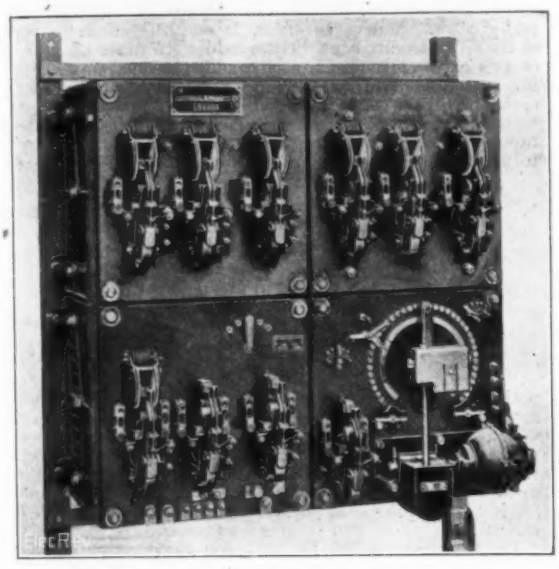


Fig. 1.—A Motor-operated Printing Press Controller.

well-known motor controllers of the Navy pattern. The motor functions at slightly over half its normal capacity, so that there is a liberal overload capacity, and provision has been made for varying its speed and, consequently, the rate of insertion or cutting out of resistance in the main motor circuit; the inching speed can also be varied to suit requirements. The device, which has been designed to control printing presses, but may with equal success be used in conjunction with machine tools and suchlike machinery, is robustly but neatly constructed, and it may be bolted on the wall or placed in any other convenient position, its function being controlled by means of push buttons, which may be located wherever desired. The buttons are five in number, namely, "start," "stop," "low speed," "high speed," and one for "inching," and they are all fitted with magnetic blow-outs. Any one of the five buttons on being depressed acts as the master button until released, so that none of the others will function if depressed in the meantime, except, of course, the "stop" button. After having seen the controller in operation, we must congratulate the makers on having produced such a neat and serviceable design; the device certainly appears to do all that is claimed for it.

A New Repulsion Induction Motor.

The *Electrical News* describes a new single-phase motor of the repulsion start, induction type, which has recently been produced by the Robbins & Myers Co. This motor is furnished for services which require high starting torque with low starting current. The motor starts as a repulsion motor. At full speed a centrifugal device operates, short circuiting each commutator bar and lifting the brushes, thus avoiding unnecessary wear. The action of this device is positive, and does not depend upon play of the armature to push the brushes from the commutator. The interior of the motor is protected by ventilated enclosing heads, a removable cover being provided on the commutator end for inspection of the commutator and brushes. The end head at the commutator end is marked for the three positions of the brush rocker arm which give clockwise and counter-clockwise rotation and neutral. The average starting torque from rest is 350 per cent. of full load torque and the average starting current is 300 per cent. of full load current. The motor will bring up to normal speed a load of from 1¼ to 1½ normal full load. The maximum running torque is over 200 per cent. of full load torque. This motor is at present furnished in ½ h.p. size only, but other sizes ranging from ¼ to 1 h.p. will soon be in regular production.

A New Bonding and Earthing Clip.

Messrs. Leopard Bros., 81, Micheldever Road, Lee, S.E.12, have sent us a sample of a new form of earthing and bonding clip designed by them. The chief novelty of the clip, fig. 2, lies in the gripping of the earth wire in the bight of a loop of

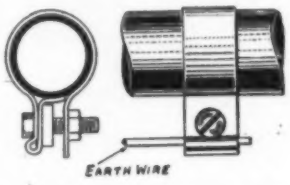


Fig. 2.—A New Bonding and Earthing Clip.

copper tape. This is a much safer arrangement than the mere retention by a screw or bolt head. The perforations in the copper tape enable one size of clip to be adapted to several sizes of conduit or metal sheathing. The design is protected by a provisional patent.

A Novel Electric Vehicle.

The accompanying illustration, fig. 3, was reproduced from a photograph of a unique little electric vehicle which has been specially designed for the use of town shoppers and invalids. It is known as the Lewis Electric Sedan, and its leading features are the ease with which it can be controlled, moderate speed, and low operating cost, which is said to amount to only one halfpenny per mile. It is without doubt one of the lightest and neatest machines on the road, and without passengers it turns the scales at 6½ cwt. As will be seen, it is of the 3-wheel type, and will accommodate two passengers who are completely protected from wind and rain. There are no foot pedals at all. One lever controls

Fig. 3.—A Lewis Electric Sedan.

the operating switch and at the same time works a brake fitted to the rear wheel. A second brake is operated by means of Bowden wires which are attached to the tiller steering arm. The propelling energy is furnished by a battery of Tudor accumulators which is large enough to enable the vehicle to run, it is claimed, a distance of 50 miles on one charge, the speed attainable being about 10 m.p.h.

A New Electric Vulcaniser.

We have received particulars of a new electrical vulcaniser for rubber tires from Mr. T. H. Warburton, 81, Cannon Street, E.C.4. The apparatus (fig. 4), which is designed for connection to an ordinary lighting supply of 100, 150 or 250

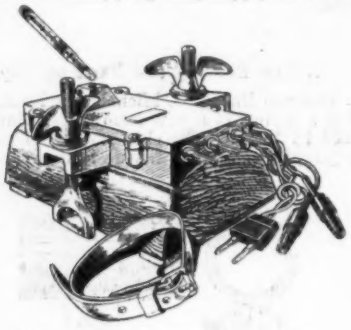


Fig. 4.—An Electric Vulcaniser.

volts, consists of a heating element contained in an aluminium case. A shaped wooden block is placed under the tire, and the bottom of the aluminium container is formed to fit over the top of the tire and the two are braced together by a steel bar and bolts and wing nuts. An opening in the top of the case permits the insertion of a thermometer, which is specially calibrated to indicate when the correct temperature is reached for various kinds of repairs. It is possible with this device to vulcanise parts of an outer tire cover without removal of the tire. The illustration is reproduced from the motor.

An Electric Egg Tester.

We have recently received inquiries regarding electrical egg testers, and the description given by the Toronto *Electrical News* of a tester recently put on the market by the Stumpp and Walter Co., of New York, may be of interest. The apparatus consists of a box containing a dry battery and a small lamp. A cylindrical hood projects from the top of the box, and the lamp circuit is closed by placing an egg upon the top of this hood. The battery is capable of holding out for the testing of between 15 and 20 thousand eggs, and so "running charges" are negligible.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS FOR MAY, 1921.

Compared with the previous month, there was an increase of about 20 per cent. in the total value of exports during May. A slight decrease occurred in the import figure, while the total value of re-exported goods fell by approximately 44 per cent. The most prominent item in the export figures is that of "submarine telegraph and telephone cable," which was twice that of the previous month. Increases also occurred in the export values of meters, traction motors, and telegraph and telephone instruments and apparatus; noticeable falls took p'ace in respect of exported glow-lamps and insulated wire. As regards imported goods, unenumerated electrical goods and machinery experienced a decline, but this was balanced by increases in most of the other items. The fall in the value of re-exports was occasioned chiefly by a large drop in the item of "meters."

Values of Electrical Exports and Imports for May, 1921.

	Exports.	Imports.	Re-exports.
Electrical goods and apparatus (unenumerated)	£174,649	£43,021	£7,999
Insulated wire	313,537	13,042	956
Glow lamps	46,798	25,998	134
Arc lamps and parts	3,193	2,922	—
Batteries	71,908	5,941	—
Meters	46,727	14,936	2,685
Carbons	3,134	8,544	39
Electrical machinery:—			
Railway and tramway motors ...	33,695	—	—
Other motors and generators ...	251,649	—	—
Electrical machinery (unenumerated)	174,281	93,622	1,377
Switchboards (not telegraph or telephone)	16,826	3,115	—
Telegraph and telephone cable and material:—			
Telegraph and telephone wire and cable (not submarine)	128,075	5,155	—
Submarine telegraph and telephone cable	807,090	—	—
Telegraph and telephone instruments and apparatus	171,642	28,347	2,829
Totals... ...	£2,243,204	£244,643	£16,019

THE "GLO-CLAD" WIRING SYSTEM.

In the past we have described many wiring systems each possessing its distinct features and advantages, although all have much in common. The same may be said of the "Glo-clad" system designed by Messrs. W. T. Glover & Co., of which some particulars are given below.

It is claimed that the "Glo-clad" system fulfils all the requirements expected of an efficient installation, that is, it is watertight, gastight, acid-proof, and electrically continuous; in addition, it is said of the system that the important item of cost, which includes maintenance, bears comparison with that of systems requiring less initial outlay.

The "Glo-clad" system is an "open" one. The cables are rubber insulated and protected by a sheath of lead alloy which, while of comparative hardness, is ductile enough to permit of its being readily bent. These cables are made up with one or two cores as required, each conductor consisting of 3/.036 in. wires, the twin cable being designed primarily for a.c. circuits. The junction box is of cast iron into the outlets of which brass glands are screwed. These glands bear an internal thread and the metal sheath of the incoming cable is screwed to fit into the gland; a packed lock-nut holds the gland in

Fig. 1.—Final Position of Gland (Section).

position, and prevents the access of moisture. Fig. 1 shows in section the arrangement described, and fig. 2 gives a plan view of a fitted 4-way junction box. It will be seen from the view of the box that the wires are bunched into connectors which are completely enclosed in porcelain, and this rests upon a porcelain base. The joint between the box and its lid is of the tongue-and-groove type, and is made up with watertight packing and secured by four screws.

The cables are ordinarily run upon wood strip—where this can be screwed to ceilings and walls. In the case of steel girder roofs a special steel tray is employed. Fig. 3 shows these systems in use, both steel tray and wood strip; a watertight switch specially designed to suit the system is also seen in this illustration. A very useful tool supplied with this system serves a three-fold purpose. It takes the shape of a pair of pliers, but the head is divided into three parts, one for cutting the sheath of single "Glo-clad" cable, one for cutting the twin cable, and a centre part for stripping the rubber insulation from the conductors.

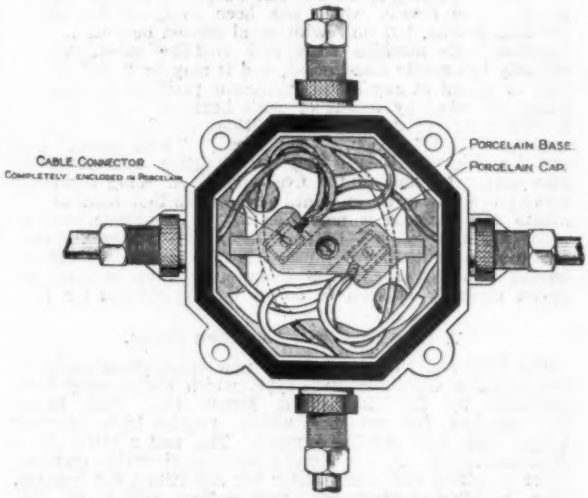


Fig. 2.—Four-way Junction Box.

The method of procedure in installing the "Glo-clad" system is briefly as follows: The cable supporting strips, wood or steel, are first fixed in position, and then the junction boxes and switches are fixed. The cables are then run along the supports, six feet or so being left unclipped temporarily on either side of each joint or terminal, and sufficient slack allowed for easy handling and connecting. The lock-nuts upon the glands are run back to the hexagon head, and the gland is screwed well into the box. The cable end is then trimmed and screwed with a special die which enables the correct length of thread to be gauged. The interior porcelains are removed from the box, and the cable is threaded through the gland. The cable is pulled home so

that no slack is left outside the box, and the correct position of the cable within the gland is thus assured. The gland is then unscrewed from the box and thereby screwed on to the threaded cable, and the locknut is brought up into position against the end of the box socket. The connections are then

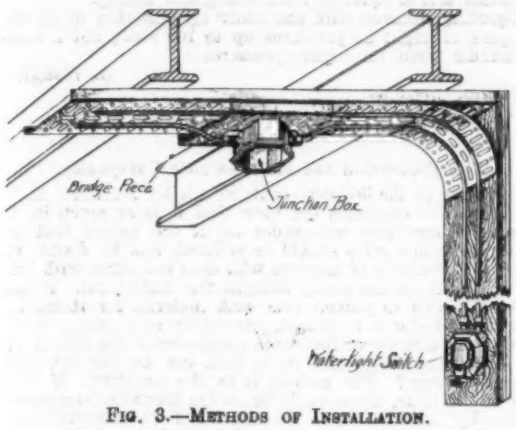


FIG. 3.—METHODS OF INSTALLATION.

made, and the porcelains put into position. Special lids for the boxes have been designed to meet various lighting requirements. Other fixtures are multiple switch boxes containing three or five switches in one case, combined switch and distribution boxes, and distribution boxes with fuses mounted on hinged bars enabling them to be swung out for inspection or replacement.

ELECTRICAL DEVELOPMENT IN JAMAICA.

THE Kingston correspondent of *The Times Trade Supplement* says that two exhaustive reports on the subject of hydro-electric supply and the electrification of the Jamaica Government Railway have been presented to the Legislative Council for consideration this year.

Mr. H. Howard Humphreys, who visited the island during 1920 and made an investigation on behalf of the Colonial Government, deals with four rivers in the central portion of the island in his report. These streams conform to the necessary stipulations, and he points out that in normal times their development would have been a comparatively cheap matter as no impounding dams and other expensive works are necessary; the pipe and conduit lines are short, while the fall, volume of water, and constancy of flow are satisfactory within the required limits of power. As the pipelines and conduits will be laid north and south, there does not appear to be any grave risk from earthquake shocks in the locality. Owing to the possibility of earthquake damage and for other reasons, it is desirable to avoid the eastern end of the colony.

The estimated cost of the works projected with steel at its present high price, and on the assumption that the pipes are purchased in the United Kingdom, is £420,450. Should the pipes be purchased in the United States together with reinforcing steel, a saving of £18,000 is anticipated. The estimates provide for the whole of the engineering work from the intakes to the turbine inlets and other charges.

Seven transformer sub-stations are recommended on the two main sections of the railway at a cost of £160,000, ranging from 500 to 1,500 kW. For overhead trolley, feeder, transmission, and telephone and telegraph lines the cost is estimated at £800,000; and for the purchase of 21 electric locomotives, at £273,000. The cost of the whole enterprise is placed at £1,970,240.

Mr. Humphreys's report was referred to Messrs. Preece, Cardew & Rider, who advised the Crown Agents that in the first instance three power stations should be provided with 13,000 water h.p. or 7,280 kW; power would also be available for industrial and lighting purposes. With a plentiful supply available, the question of irrigation should receive more attention, as pumping schemes, which have hitherto been too costly, could be undertaken. Direct current is recommended for the railway.

The consulting engineers are convinced that the rivers tested are sufficient to give power to operate the railways and leave a considerable margin for other purposes; development of the rivers would render the island practically independent of the coal supply for power purposes; the island would thus become self-supplying. Electrification of the railway would bring about considerable improvement in the passenger and traffic services, while a supply of electrical energy at reasonable rates should encourage the development of new industries and add to the general prosperity of the island.

LEGAL.

AN IRISH ELECTRICITY AGREEMENT.

AT Carrick-on-Shannon Quarter Sessions, before Judge Brown, an interesting case was listed, in which Messrs. Telford, Grier and McKay, electrical engineers in that town, but having an office in Glasgow, sought to recover from consumers amounts due for electric lighting supply.

It apeared that, by an agreement between the company and the Carrick-on-Shannon District Council in 1917 for the public lighting of the town and the pumping of the water supply, it was provided that the rate per unit to private consumers should be 6d. for light up to a certain amount, and then 3d. The company found that it could not continue supply at these rates, and proposed to charge 9d. per unit. Business houses and other private consumers refused to pay this increased rate.

For the company, Mr. Gillespie held that the company could not, and should not, be asked to supply at a loss. Notice of the increased charge had been duly served, and instead of refusing to take the supply the parties had gone on using power. His view was that the District Council had no power to make an agreement on behalf of private consumers.

His Honour decided to give a decree for each amount, as claimed. He was of opinion, with Mr. Gillespie, that the Council had no power to make such an agreement. If private consumers had signed the agreement it would have been a different matter.

BASTIAN ELECTRIC CO., LTD.

THE petition of W. F. N. May and Another for an order for the compulsory liquidation of the Bastian Electric Co., Ltd., was before Mr. Justice P. O. Lawrence in the Companies' Winding-up Court on Tuesday (June 14th).

Mr. DIGHTON POLLOCK, for the petitioners, said it stood over for 14 days to see if anything could be done to pay off the claim. Certain negotiations were going on, he thought, which might result in a settlement. He therefore asked for another week's adjournment.

This was granted.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Electric Light Wiring Systems.

With reference to the recent discussion in your columns, I am enclosing herewith a few samples of cab tire cable which has been in use for about three or four years.

It was run on porcelain insulators in the open air, but was protected from the direct effects of the sun and weather by a roof. The wires were kept from 2 in. to 3 in. apart.

In the majority of cases it has failed at bends and also underneath the insulators.

I may add that it was immune from steam rollers.

Wireman.

June 10th, 1921.

[Some of the faults take the form of cracks in the sheathing at bends; other samples show unmistakable evidence of severe local overheating. Apart from these features, the sheathing appears to be in its normal condition.—EDS. ELEC. REV.]

An abstract of the above paper by Mr. F. T. Alldread, and of the discussion on the same, published in your current issue, refers so frequently to C.T.S. wiring, and in some cases with such a lack of knowledge of the subject, that we trust you will allow us to deal with the matter in your columns as briefly as possible.

To begin with, Mr. Alldread has invented a new name for C.T.S., namely, "Hard rubber-cased V.I.R. wiring." We fail to see the need for rechristening this well-known type of cable, and would also point out that "hard rubber" is almost a standard phrase for ebonite, and so is likely to be misunderstood, especially by American readers. Mr. Alldread states that the sheathing cracks at a considerable period after installation where the wires have been bent at a very sharp angle. This statement is hardly worth dealing with unless as a very exceptional case, in view of the fact that Mr. Alldread later states that *he has no experience of cab tire cable!*

Mr. Garbett states that he had found serious difficulty with cab tire cable at the ends, principally with regard to the risk of contamination with printers' ink and rough usage.

We know nothing about troubles from this, but are confident that C.T.S. will stand up to both items better than any other cable protecting material.

Regarding the ends of cables where exposed to the elements, Mr. Garbett says he has never yet seen any system which

dealt with troubles from this exposure. He, therefore, must be unaware of the St. Helens corrosion-proof fittings, of which many thousands are in use, in corrosive and weather-exposed situations.

Mr. Crowdy calls C.T.S. "funny stuff," but does not explain where its humour comes in, except to state that some people prefer to use it and others refuse!

He also states that the ends of C.T.S. cable are a serious matter with regard to the shrinking of the sheathing from fittings after erection.

The only explanation we can give for such an exceptional experience is that the sheathing has been pulled too tightly down to the fittings mentioned, and later the rubber has been allowed to gradually ease back; but there should be no need for such an abuse of the elastic properties of the sheathing. We have had these works and offices completely fitted up with C.T.S. for power, lighting, heating, telephones, &c., during the past eight or ten years, with the main object of finding out any defects, but have been unsuccessful so far, even with regard to the shrinking peculiarity mentioned by Mr. Crowdy, nor have we heard of this before from any other user.

Mr. Whitley states that the manufacturers of C.T.S. wire made a great mistake in recommending it for any or every purpose, and that though for certain purposes it was extremely useful, there were circumstances where it should not be used.

It is a pity that Mr. Whitley did not mention these unusable circumstances to make his statement useful as well as merely vaguely detractory.

We beg to reply that we do *not* recommend C.T.S. for any purpose for which it is in the slightest degree unsuitable. For instance, a letter appeared in your columns recommending C.T.S. as being best for hot situations, whereupon we immediately wrote to contradict this, so far as situations under considerable and continual heat are concerned. We also do not recommend C.T.S. for underground mains (as mentioned by Mr. Revell), as, although it is used for mains where sewers are the only available conduits, this is merely because there is no room in the road for other conduits to be put down, and no other type of cable would stand the conditions inside sewers. For ordinary mains work it is too expensive.

In conclusion, may we suggest to compilers of papers on the very important and interesting subject of wiring, and to those who intend to discuss such papers, that if they are in any doubt about C.T.S., on applying to this company they will receive full information as to its advantages *and limitations*.

St. Helens Cable & Rubber Co., Ltd.,
J. H. C. Brooking,
General Manager.

Warrington.
June 13th, 1921.

[It should be remembered that the paper and discussion referred to were both severely condensed before publication in our columns.—Eds. Elec. Rev.]

With reference to your report of the interesting discussion on various systems of wiring, I would like to make a few remarks.

I have had 22 years of electrical wiring, and am conversant with all systems. I will take the various systems in their order:—

Screwed tubing, lead-covered paper-insulated,, lead-covered vulcanised rubber, wood casing, and cab tire.

All the above systems are quite in order when installed in dry places, but are failures in exposed and damp atmospheres.

You will notice I have omitted c.j. tubing, either with continuity grip fittings or push-on fittings; neither of them are satisfactory, and I would prohibit them, as it is impossible to get a proper continuity job.

Concealed Work.—Under floors and plaster, &c., you are reduced to fewer systems. Screwed tubing, lead-covered vulcanised rubber, lead-covered paper-insulated, cab tire, but not wood casing.

For the past 18 months I have been acting as temporary installation inspector to a large Corporation electricity undertaking, and I can honestly say I have come across very few good jobs done in casing. Twenty years ago you would get splendid casing jobs, but the wiremen of to-day don't or won't understand it.

For all vertical runs behind plaster I would insist upon nothing else but heavy-gauge screwed steel tubing and fittings, whatever the system; if lead sheathing is used, the tubing to be bonded to the lead.

Damp Situations.—I have tried every system, and have been reduced to two that have stood the test, namely, cab tire and vulcanised rubber and braided stranded wire run on bobbin insulators (not cleats), and bound with tar marlin cord.

The various engineers were quite in order when they stated that the terminal ends of the cab tire split or reduced, leaving bare wires. I got over this difficulty by binding the ends with good quality adhesive Para rubber strip ¼ in. diameter. In large works or warehouses, provided you have plenty of ceiling height, h.d. stranded copper wire run on insulators for the line wire would be in order. For the above system I use porcelain covered switches such as the D. & S. or Premier make.

For a suitable cheap house wiring system I would recommend the B.I. & H. system of lead-covered paper-insulated wire, but instead of using lead trays or boxes for jointing, I would suggest front recessed wood blocks and bottle wax or low-grade sealing-wax—not the wax recommended by the makers—and using the usual bonding clips for earthing.

I have installed thousands of lights on this system, and have found it low both in cost of labour and material, also the insulation test is equal to wood casing and lasting.

Regarding Stannos wire and other systems akin to it, they are quite all right on pressures up to 100 volts, but I would not handle them for higher pressures.

G. Hough.

Oldham.
June 12th, 1921.

Fire Prevention and the Insurance Companies.

Your issue of the 3rd inst. contains a letter from Mr. E. W. Hubbard, who expresses the view that it is as much in the interest of insurance companies as of the public that the former's fire loss ratio should be reduced, and he doubts the actuarial experience of any one who does not agree with him.

I wonder if he has really thought the matter out. It may be worth while to provide him with material for thought.

First of all—for it is best to proceed by easy stages—would it be in the interest of insurance companies if the risk of fire was eliminated altogether, if, in fact, the fire loss ratio was reduced to zero? The answer is in the negative. If there were no fire risks, there would be no fire insurance companies.

Secondly, would it be in the interest of the insurance companies if the risk of fire was diminished by one-half or any other percentage one likes to name? The answer is still in the negative, for exactly the same principle applies. If the risk of fire is reduced, premiums tend to fall. It is true the fall may be prevented or delayed by the elimination of competition and other artificial bolsterings, but the tendency exists.

Thirdly, since the fire loss ratio is the percentage of premiums paid by the public which they receive back in payment of fire claims, the greater the percentage they receive back the better it is for them and the worse for the companies. An abnormally low fire loss ratio means that the insurance companies are charging too much premium. That is the complaint as regards "protected risks." The loss ratio is much too low.

Fourthly, since the real concern of the insurance companies to-day is their expense ratio, reduced premium income hurts their most tender spot, for a reduced premium income means an increased expenses ratio.

No one wants bureaucratic interference if it can be avoided. One would prefer to rely on the broad outlook, the public spirit, and the wise unselfishness of the giants who hold the insurance monopoly. If only these qualities were a little more apparent!

F. Collett.

London.
June 13th, 1921.

Kinema Supply.

In "Lindsell v. Paignton Electric Light Co., Ltd.," you reported in April, 1920, that Mr. Justice Bailhache's decision was that the energy used for the motor generator "... *must* be paid for at the lighting rate."

I should be glad to know whether supply authorities generally are charging the lighting, power, or an intermediate rate for this supply.

C. Culmer Hodges.

Dawlish Electricity Works.
June 9th, 1921.

[Supply authorities are not bound by the decision in the Paignton case; they can formulate any tariff they please for kinematograph theatres as a class of consumer. From data that we collected in 1919 it appeared that practice was very variable, all three methods mentioned by our correspondent being in use.—Eds. Elec. Rev.]

Wear of Rotary Converter Slip Rings.

I was very interested to read in your issue of May 20th an article by "Koocaf" regarding uneven wear of slip rings on a rotary converter. While I agree with his suggestion, and also Mr. W. G. Stuart's remarks as to the transference of metal from brush to ring or ring to brush, there is, I think, another action taking place which has a greater effect. The friction between two rubbing surfaces such as a slip ring and a brush varies according to the amount of current flowing between them, being greater with a heavy current than with a small current, and consequently the amount of wear will vary also. I am in charge of rotary converters where the angular distance between the brushes on the slip rings is equal to the angular distance between the north and south poles on the field of the machine, but still the flats form very badly. They are ten-pole machines, and there are ten high places and ten hollows on each ring, thus proving that this other action is present. I think that if it could be arranged to place two brushes, one each to correspond with a north

and a south pole, and two more to correspond with positions between the poles (on a ten-pole machine that would mean two brushes 36 deg. apart and two more 36 deg. apart, but either 18 deg. or 54 deg. form the other pair), it would practically do away with the uneven wear. The other alternative would be to provide some means of shifting the brushgear round to a different position periodically, but I should prefer the first method myself.

Bernard T. Smith.

London.
June 8th, 1921.

The Lubrication of Ball Bearings.

In fitting ball bearings to dynamos and motors there seems to be a divergence of opinion between various manufacturers as to the provision of lubricators, some being in favour of the use of a screw-down grease lubricator, and others fitting no lubricator whatever.

Ball bearings require very little lubricant. I have found that a bearing properly washed out and packed with grease will give perfect service for at least a year without attention. It is desirable that a ball bearing should be thoroughly washed out at least once a year.

If lubricators are fitted, the tendency, especially with unskilled labour, is to fill them up with grease, or possibly oil, to such an extent that the surplus is frequently distributed over the commutator and windings.

No doubt there are very good arguments in favour of fitting lubricators, and an expression of opinion by your readers, I am sure, would be of great interest to dynamo and motor manufacturers who standardise on ball bearings.

J. C. Todman.

London.
June 9th, 1921.

"Though One Rose from the Dead."

Several months ago I ventured to make a simple statement of fact which was not well received by some of your correspondents, and I now enclose a short report of a recent speech of Mr. Robert Fleming, at the meeting of the Investment Trust Corporation, from which I take the following remarks said to have been made by the late Lord Moulton:—

"There is no prospect of our being able to bear the burdens of the future unless by advances in technology—the science of the industrial arts—we are able to produce better and more cheaply than our competitors."

Are there still any dissentients?

W. H. M.

June 11th, 1921.

The Grading of Mains Engineers.

The correspondence on the above subject is very interesting, and no doubt our worthy brothers—Charge and Mains Engineers—have all grievances, but both of these gentlemen seem to forget the meter engineer, a grade which is not even mentioned in the Award 9,281, not the E.P.E.A. Award alone, because there are members belonging to the E.T.U. as well as the E.P.E.A. "Meters" has been for years looked upon by the powers that be as an insignificant occupation, yet if probed in all its branches, it should rank with the charge and mains engineer. The whole question is involved by the fact that the "Stoker" Award 9,281 is too obscure. There should be a schedule laid down giving grades to all the technical staff; at present it gives great prominence to just two or three grades. My 25 years' experience convinces me that the mains engineer should be recruited from the mains department, not from the generating station—that is, promote a mains foreman who, after all, is the man that should know. Do any of your readers know of any grading for the

Meter Engineer?

June 4th, 1921.

A Peculiar Phenomenon.—"H. E." desires to thank Mr. C. R. C. Hadfield for his clear and interesting explanation of this.

BUSINESS NOTES.

Bankruptcy Proceedings.—J. F. Lyons, electrical engineer, Front Street, Consett, Durham.—The first meeting of creditors was held on June 8th at the Official Receiver's Office, Pearl Buildings, 4, Northumberland Street, Newcastle-upon-Tyne. According to the statement of affairs the liabilities amounted to £1,208, against assets estimated to realise £529, or a deficiency of £679. No cash book had been kept by the debtor. He had entered into a contract under the Chester-le-Street housing scheme. The creditors decided to appoint Mr. A. E. Carr, of Newcastle, as trustee of the estate, with a committee of inspection. The public examination herein was fixed to be held on June 9th at the County Court, Westgate Road, Newcastle-upon-Tyne, but the debtor did not appear (by permission of the Official Receiver), and the examination was adiourned.

T. P. Pollit & Co., Ltd., electrical and mechanical engineers, Fish Dock Road, Grimsby. The following are creditors:—

Bates, J. G.,	£26	Pethers, Ltd.	£26
Edison Swan Elec. Co., Ltd.,	1,803	Pilkington Bros.	10
Falk, Stadelmann & Co., Ltd.	18	Roberts & Jackson	15
Grimsby Tramways Co.	18	Roberts, R. W.,	11
Hildred, Geo. (Meters), Ltd.	22	Sisson, W., & Co., Ltd.	91
Hansdell & Co., Ltd.	23	Siemens Bros. & Co., Ltd.	74
Kaye & Sons	32	Taskers Engineering Co., Ltd.	23
Legal Insurance Co.	19	Walker, R. C., Ltd.	12
Morley & Co., Ltd.	226	Reeves, A. R.,	15
Napier Kimber, Ltd.	32	Smethurst, J. W.,	77
Nicholson Bros.	13	Pollitt, M.	25

S. H. Dougherty (Mersey Electrical Co.), electrical engineers, Liverpool.—Trustee (Mr. H. W. Bowler, 30, North John Street, Liverpool) appointed June 7th.

Alfred John Harrison, trading as the Xtra Lighting Co., 4, 5 and 6, Old Market, Sunderland, Durham, electrical and gas engineer.—The adjourned public examination of this debtor was held recently at the Court House, John Street, Sunderland. He was questioned with reference to his financial affairs, and the examination was closed.

R. B. Hand & Co., Ltd., electrical engineers, 63, High Holborn, W.C.—In pursuance of the provisions of the Companies (Consolidation) Act, a meeting of the creditors of the above was recently held at the offices of Mr. Charles May, solicitor, 175, Lavender Hill, London, S.W. It was explained that the meeting had been called as the shareholders had passed a resolution in favour of voluntary liquidation, and had appointed Mr. P. J. Hooper, of 53, The Broadway, Wimbledon, S.W., as liquidator. According to the statement of affairs presented, the liabilities totalled £3,952, while the assets comprised stock, fixtures, and fittings, amounting to £1,942, which were estimated to realise £1,096. The liquidator stated that he had not been able in the time at his disposal to prepare any figures regarding the trading, and he could not give a detailed account of how the deficiency had arisen. The company was registered nearly two years ago with a nominal capital of £1,000. The issued capital amounted to £800. The creditors passed a resolution asking the company to appoint Mr. W. J. Osborn, of Messrs. Corfield & Cripwell, I.A., Balfour House, Finsbury Pavement, E.C., as the joint liquidator of the company, together with a committee of five of the principal creditors.

F. E. J. Padmore, electrical contractor, Marlborough Road, Nuneaton.—The public examination was held at the Coventry Bankruptcy Court on Monday last before Mr. Registrar Kirby. The statement of affairs showed liabilities £211, assets nil. Debtor stated he commenced business in November, 1918, with £5 capital. The causes of failure were keen competition and loss of trade through the strike, and also illness. The examination was closed.

T. Hardman, electrician, Rawtenstall.—First meeting, June 21st at the Official Receiver's offices, Manchester. Public examination, July 15th, at the Public Hall, Roohdale.

C. T. Stanton (Southern Electric Engineering Co.), electrical engineer, 25, Beckenham Road, Penge.—Last day for proofs for dividend, June 29th. Trustee, Mr. T. Gourlay, Official Receiver's Offices, 132, York Road, E.C. 1.

Dissolutions of Partnership.—E. E. Clarke & Co., electrical engineers and contractors, 4, Alhambra Buildings, Morecambe.—Messrs. E. E. Clarke and H. Schofield have dissolved partnership. Mr. Clarke will attend to debts.

Willis & Shaw, electrical engineers, 37, Haley Hill, Halifax.—Messrs. H. Willis and S. Shaw have dissolved partnership. Mr. Willis will attend to debts.

Fowler & Jones, electrical engineers, 1A, Menzies Street, Liverpool.—Messrs. H. Y. Fowler and A. E. Jones have dissolved partnership. Mr. Fowler will attend to debts and continue the business.

Henry Jones & Co., electrical and general engineers, 80 and 49, Ebury Mews, Eccleston Street, S.W.—Messrs. H. Jones and N. A. Usmar have dissolved partnership. Debts will be attended to by Mr. Jones, who will continue the business under the same style.

Trade Announcements.—Mr. S. Betts, lately with Messrs. J. H. Winter & Co., of Bristol, has commenced business as an electrical engineer at 63, Oxford Street, Weston-super-Mare.

Messrs. Perry, Savage & Co., electrical engineers, have commenced business at 28, Conway Street, Birkenhead.

Messrs. Booth & Bomford, Ltd., electrical engineers, have removed to 22, St. Andrews Crescent, Cardiff. Telephone number, 1466. Telegrams, "Induction, Cardiff."

Messrs. Williams, Pell & Baring, Old Serjeants' Inn Chambers, 5, Chancery Lane, W.C. 2, have been appointed sole agents for the United Kingdom for the sale of electrical machinery and apparatus made by the Heemaf Co., of Hengelo, Holland.

Allied National Corporation, Ltd., engineers and export merchants, of 34, Great Tower Street, inform us that after June 28th their address will be 72-74, Victoria Street, S.W.

Messrs. A. J. Wright & Co., manufacturing electricians, have removed from 61, Eden Grove, Holloway, N., to 395, City Road, E.C. 1.

Messrs. C. H. Runnalls, electrical engineers, of Sutton (Surrey), have removed their business from 6, St. Barnabas' Road, to new premises in Grove Road.

THE FOREST CITY ELECTRIC SERVICES CO., LTD., of 39, Chapel Street, Salford, will on June 20th remove their offices and stores to new premises as under:—Offices, 10, Princess Street, Chester Road, Manchester; stores, 2 and 4, Cornbrook Road, Manchester. The telephone number will remain unchanged.

Catalogues and Lists.—MESSRS. ANDERSON & BURGESS, 122, Wellington Street, Glasgow.—A type-written stock list of paper of various kinds. Priced.

MESSRS. RAYNER & HEALD, LTD., Duke Street, Derby.—Stock list of two- and three-phase squirrel-cage and slip-ring induction motors.

THE PRIORY ELECTRICAL ENGINEERING CO., Bath Street, Birmingham.—An illustrated leaflet describing a new type of ceiling rose fitting.

MESSRS. W. J. BITHELL, LTD., Whitehall House, 29-30, Charing Cross, S.W. 1.—An illustrated booklet, dealing with automatic grabs for excavating, dredging and lifting.

MESSRS. W. T. GLOVER & CO., LTD., Trafford Park, Manchester.—List No. 14, describing in detail the "Glo-clad" wiring system. Full illustrations and prices are included.

THE MIRRLEES WATSON CO., LTD., Scotland Street, Glasgow.—An illustrated pamphlet, giving particulars of surface-condensing plant installed in the Dalmarnock station of the Glasgow Corporation.

MESSRS. WILLIAMS, PELL & BARING, Old Serjeants' Inn Chambers, 5, Chancery Lane, W.C. 2.—A number of illustrated descriptive pamphlets dealing with the products of the Heemaf Co., of Holland, which include motors, switchgear, &c.

AUTOMATIC AND ELECTRIC FURNACES, LTD., 281-283, Gray's Inn Road, W.C. 1.—Heat Treatment Bulletin No. 28, "The Heat Treatment of Carbon Tool Steel." This is a full, but condensed, description of tool-steel production, with details of the various processes, such as forging and rolling, full and short annealing, normalising, hardening and tempering.

MESSRS. UNDERWOOD (MANCHESTER), LTD., 53, Brown Street, Manchester.—Leaflet No. 23, illustrating "Moonstone" half-watt fittings (bowls). Priced.

THE EDISON SWAN ELECTRIC CO., LTD., Ponders End., Middlesex.—List No. H H 226, a comprehensive catalogue of electric fans for all purposes, with descriptions of special accessories such as automatic shutters, regulating resistances, oscillating bases, adapters, &c. Fully priced and well illustrated.

ENGINEERING AND COLLIERY APPLIANCES, LTD., Sheffield.—Two leaflets giving particulars and prices of "Ecal" hack-saw blades.

Catalogues Wanted.—THE SCIENTIFIC ELECTRICAL WORKS, electrical engineers and instrument makers of Charlotte Street, Dublin, desire to receive catalogues from manufacturers of electrical machinery, apparatus, and accessories, &c.

MESSRS. HAMILTON & LIDDAMAN, LTD., factors, of 12, Charing Cross Road, W.C. 2, will be pleased to receive catalogues and price-lists of electrical apparatus, accessories, cable, &c.

Book Notices.—"Aluminium Facts and Figures." 68 pp. London: The British Aluminium Co., Ltd. Price 5s. net.—This is a new and revised edition of a pocket-book of great value to all who are connected with the use or supply of aluminium. Everything which it is desired to know about aluminium appears to be included. Full details of the physical, mechanical, and electrical characteristics of aluminium and its alloys are given, and a comparison is made in most cases with the equivalent properties of copper. Many details and directions for working are given, such as hammering, spinning, pressing, jointing, polishing, &c. Other particulars too numerous to mention are given in comprehensive tables.

Scientific Paper of the U.S. Bureau of Standards No. 410, "Thermal Expansion of Copper and Some of its Important Alloys." 69 pp. Washington: Government Printing Office. Price 25 cents.—This publication gives data on the thermal expansion of 128 samples of copper and its alloys of various compositions under heat treatment, mechanical treatment, &c.

The *Decimal Educator* for June contains, *inter alia*, extracts from a memorandum by Mr. Harry Allcock on the importance of the adoption of the metric system in this country for the development of foreign trade, and from a lecture by the hon. secretary of the Decimal Association, Major G. E. M. Johnson, explaining the use of decimal costing methods in the offices of a large engineering firm. It is published by the Decimal Association, price 6d.

"The Technology Reports of the Tôhoku Imperial University, Sendai, Japan." Vol. II, No. 1. Pp. 40. Tokio: Maruzen Co., Ltd.—Included in this issue are "A Fundamental Study of Japanese Coal," "The Energetics of Telephone Receivers," "On the Discharge through an Aluminium-Cell Lightning Arrester," and "General Consideration of an a.c. Circuit with Periodically Variable Resistance."

Credit for Mexican Importers.—The British Vice-Consul at Guadalajara, Mexico, reports that local merchants are showing great interest in the importation of United Kingdom manufactures, but, the development of business is being seriously hindered by the lack of standard types of credit allowed by United Kingdom firms to Mexican importers. He adds that United Kingdom manufacturers and exporters do not seem to have the courage to make clean-cut credit propositions, while many send catalogues without prices and seem to hope that orders will ensue from correspondence.—*Board of Trade Journal.*

French Moulded Insulation.—With reference to the note appearing in our last week's issue under the above title, we are informed that the submarine accumulator box shown was made for the American Navy and not the British Admiralty.

The Union of German Electrical Engineers.—The Central Union of the German Electrotechnical Industry held an ordinary meeting, under the presidency of Herr Carl von Siemens, in connection with the electrical exhibition which took place at Essen at the end of May. After mentioning that the Union had advocated the maintenance of State control over the export and import trade, the general report stated that, as a consequence of the general improvement in the supply of raw materials, it was no longer of any importance for the Union to look after the interests of members in procuring such materials. Negotiations were proceeding with the organisations concerned with regard to the prices and conditions of delivery of porcelain and of transformer sheets, and new conditions would presumably be issued in the near future.

As to the situation of the question of reconstruction in France, Herr Henrich stated that orders were to be expected in the early future from France for "weak current" installations, as it was proposed to undertake the re-establishment of entire telegraph and telephone networks in the destroyed districts. Dr. Sieg, director of the Gottfried Hagen Accumulator Works, of Cologne-Kalk, mentioned in this connection that the aggregate sum of the deliveries devolving upon the German electrotechnical industry from the reparation demands "only amounted to 2,500,000,000 marks," of which 1,500,000,000 marks applied to telephone and telegraph installations. As a consequence, "the re-establishment orders remained far behind the expectations." Thus the impression was gained that the French preferred to purchase at home, even if it were more costly to do so.

It was further mentioned that the Union of German Electrical Engineers (V.D.E.) had decided to discontinue, as from October 1st, the use of substitute metals (iron, zinc, &c.), because they are unprofitable. The Government, however, is considering a scheme for maintaining such substitutes, particularly aluminium.

For Sale.—By direction of the Disposal Board, Messrs. Bowling Bros. will sell by auction on June 28th and 29th at H.M. Dockyard, Pembroke Dock, and on June 30th at the Pembroke Airship Station, Milton, a quantity of machinery stores, including generating sets, motors, lamps, carbons, &c. For particulars see our advertisement pages to-day.

Suggested Polish Credit Scheme.—At the London Chamber of Commerce, on June 14th, Mr. S. Janicki, editor of the *Polish Economic Bulletin*, outlined a scheme for establishing Polish external trade by means of a Polish Industrial Credit Society. Mr. Janicki said that Poland was a wealthy country, but owing to the lack of guarantees, had been unable to gain the confidence of foreign merchants. To meet this need, a group of Polish manufacturers had suggested the formation of an Association with headquarters at Warsaw and a branch at Lodz. Only merchants and manufacturers owning real property in Poland would be eligible for membership, as the system of guarantees would be based upon the value of such property. Mortgage bonds in dollars, sterling or French francs would be issued, charged upon this property. Such loans would not exceed, during the first five years' working, 40 per cent. of the value of sites and buildings, or 50 per cent. of the value of plant and machinery, based on pre-war standards. The loans would be written off in periods of 15, 20 or 25 years, a sinking fund for this purpose being commenced at the end of the first five years. The society would receive 7 per cent. interest on advances, and would pay 7 per cent. interest upon its bonds. The Polish Government would be responsible for the capital and interest of the society's bonds up to, it is understood, £20,000,000.

Lead Report.—MESSRS. JAMES FORSTER & CO., in their report of June 11th, say:—"Closing prices yesterday were £23 2s. 6d. for June and £22 12s. 6d. for September, against £22 2s. 6d. and £22, respectively, at the end of last week. Each day this week we have had an active and rising market up to Thursday, when the top prices paid were £23 7s. 6d. for June and £23 for September. The intrinsic position of the metal—as we have pointed out for some time past—is very strong, in spite of the coal strike and consequent dislocation of business. . . . Consumers in London and the provinces who have been in the market this week for prompt and June supplies have found none available except from refiners' works (which means 20s. premium on market values for "foreign") or from public stocks."

Living on Capital.—At a luncheon of the National Association of Merchants and Manufacturers, last week, Lord Emmott, who presided, said that the recent war was much more exhausting and devastating than the Napoleonic wars. We were not yet on the high road to recovery, and were not getting our export trade back to any satisfactory extent. He was appalled by the apparent levity with which large classes of our people looked on the present state of affairs. The great industrial disputes in progress at present meant that we were living on our capital. The quiet way in which these disputes were being borne was a great tribute to the sanity of our people, but the fact of their existence and intensity showed a lack of realisation of the jeopardy in which the country stood industrially to-day.

Sir Drummond Fraser said that the Financial Department of the League of Nations unanimously decided, on May 31st, to recommend the application of the international credits scheme for the restoration of Austrian finances. Credit was the fundamental need, and the Ter Meulen scheme was the accepted solution. It left intact, the ordinary channels of trade and provided a reservoir of credit which could be tapped by genuine traders. The economic restoration of Austria was the key of the whole situation.

German Interests in South America. — Although through financial necessities the South American undertakings of the German Transmarine Electricity Co., of Berlin, were transferred about a year ago to the Compania Hispano-Americana de Electricidad, of Madrid, it should not be overlooked that the Germans have by no means lost interest in the great original undertaking which formerly represented a gold value of something like £12,000,000. The issue to German holders in exchange for their shares and bonds of shares and interest bonds in the new Spanish company has continued the individual proprietorship of the former and of the Swiss undertakings which are also concerned. But what is, perhaps, of particular importance to the Teutonic mind is the decision which was reached at the meeting of the Spanish company on May 31st to elect to the board of directors Dr. A. von Gwinner, E. Heinemann (Deutsche Bank), O. Olven (Berlin Electrical Undertakings Co.), and Dr. Salomonsohn (Disconto Gesellschaft). On this basis the continuation of the German hands and of German plant in the South American supply undertakings and tramways is a foregone conclusion. It would be of interest to hear what the Spanish electrical manufacturing companies and firms have to say on the question. If they formerly entertained any hopes of securing a good customer in the Compania Hispano-Americana, these expectations will doubtless be dispelled by the addition of four German directors to the board of the company.

A Telephone Charge Guide.—We have received from MESSRS. GEO. W. WHEATLEY & CO., LTD., shipping agents, &c., a useful booklet which gives the charges for telephone calls from exchanges in the Inner London zone to exchanges within a 10-mile radius, and also to stations within a 25-mile radius.

Foreign Trade.—MAY FIGURES.—The following are the values of imports and exports of electrical goods and machinery in May :—

	May. 1921.	*Inc. or dec.*	5 months, 1921. *Inc. or dec.*
IMPORTS.	£	£	£
Electrical goods, &c.	151,021	+ 39,604	+ 577,215
Machinery	1,073,697	− 444,142	− 1,283,044
Electrical machinery	93,622	+ 31,784	− 11,267
EXPORTS.			
Electrical goods, &c.	1,783,579	+ 778,369	+ 2,760,335
Machinery	6,923,072	+1,441,879	+17,038,615
Electrical machinery	459,625	+ 314,601	+ 1,351,641
RE-EXPORTS.			
Electrical goods, &c.	14,642	− 1,271	+ 75,505
Machinery	90,650	− 66,417	− 90,521
Electrical machinery	1,377	− 1,409	− 6,558

British Trade-Mark Applications.—Below is a summary of the recent applications for British trade marks in respect of goods and productions connected with the electrical trades and industries :—

Magnavox. No. 411,317. Class 8. Electrical sound-amplifying devices, loud-speaking telephones, marine telephones, aircraft telephones, &c. The Magnavox Co., 2,725, East 14th Street, Oakland, Cal., U.S.A. January 7th, 1921.

Tucker. No. 408,083. Class 8. Electric switchboards. No. 408,084. Class 13. Electrical devices, fittings, accessories, &c. No. 408,085. Class 16. Articles made wholly or partly of porcelain or earthenware for electrical purposes. J. W. Tucker & Co., Ltd., King's Road, Hay Mills, Birmingham. September 23rd, 1920.

Multi Frex. No. 413,588. Class 11. Portable high-frequency and cautery apparatus for curative purposes. Ernest J. Bradbrooke, trading as E. J. Bradbrooke, 14, Granville Place, London, W. March 19th, 1921.

Spondella. No. 410.335. Class 50. Artificial filaments and fibres made wholly or principally from cellulose derivatives. British Cellulose and Chemical Manufacturing Co., Ltd., 8, Waterloo Place, London, S.W. December 2nd, 1920.

Turbolite. No. 409,005. Class 6. Electric generating machines. Henry E. Elrod Co., 220, Interurban Buildings, Dallas, Texas, U.S.A. October 22nd, 1920.

Three Star. No. 412,165. Class 8. Electrical accumulators (not for medical purposes), electric lamps, dry batteries, &c. John Abrahams & Co., 54, Redcross Street, London, E.C. February 2nd, 1921.

Greenbat. No. 401,878. Class 22. Electric trucks. Greenwood and Batley, Ltd., 16, Great George Street, Westminster, S.W. March 15th, 1920.

Wittonite. No. 413,750. Class 50. Insulating preparations, electrical. General Electric Co., Ltd., 67, Queen Victoria Street, London. March 24th, 1921.

Engineers' Continental Tour.—Part of the investigations of the Engineering Trades Joint Committee, says the *Manchester Guardian*, have been completed. The members include representatives of the Employers' Federation and of the Trade Unions, and their tour of Continental engineering centres has been a revelation of the efficiency of the organisation of the trades in Belgium, Holland, and Germany, and the anxiety and willingness to increase outputs.

One of the objects, so far as the labour side is concerned, is to obtain data as to the desirability of instituting generally a 44-hour week. On the Continent it is noted that a 48-hour week is worked, and selling prices are much lower than ours. While British shipyards pay £19 per ton for British ship-plates, Germany is sending ship-plates to Holland for £6 10s. per ton.

Tramway Workers' Wages.—Convened by the United Vehicle Workers, a conference of delegates representing tramway employés throughout the United Kingdom was held at the Central Hall, Westminster, on June 13th, to consider a proposal of the employers to reduce wages by 5s. a week. Tram drivers, conductors, washers, and other workers in the yard affected by the scheme number in all some 150,000. No official statement was issued at the close of the conference, which lasted over four hours, but it is understood that arrangements have been made for a negotiating committee representing the workers to confer with the employers in London on Thursday (yesterday), with a view to reaching an agreement.—*Daily Telegraph.*

In connection with this matter the *Daily Herald* states that the employers have not put into operation the recommendation of the Court of Inquiry, held in March last, that the wage standards existing in March should be stabilised until December 31st next.

The Engineering Wages Dispute.—On Tuesday last both parties to the wages question in the engineering industry sat in full session to discuss means of agreement. The original proposals of the employers' side were, a reduction of 3s. per week as from June 16th, a further reduction of 3s. per week as from July 16th, and the cessation of payment of the "Churchill" 12½ per cent. bonus in September. Against these proposals the Trade Unions put forward the following alternatives, which they intimated would be acceptable to their members :—A reduction of 6s. per week in time rates, and 15 per cent. in piece rates in two instalments—the 12½ per cent. and 7½ per cent. bonuses to remain. The employers would not entertain the idea of this arrangement, but modified their original terms by extending the period over which the reductions would be effected. The Unions replied that if the notices of reduction were suspended for a fortnight a ballot would be taken among their members upon these last proposals. To this the employers would not agree, and a stoppage of work appeared probable. It was suggested that the employers' proposals would be voted upon by the workers during the first fortnight of the closing of the works.

On Wednesday Dr. Macnamara met representatives of both sides in the hope of averting a stoppage.

As we go to press we learn that the employers have agreed to suspend their notices until the end of June, in order that a ballot of the employés may be taken.

Tenders for Public Contracts in Argentina.—The Commercial Secretary to H.M. Legation at Buenos Ayres, in a report on the above subject, states that with regard to contracts for which tenders are invited locally, United Kingdom firms cannot tender direct but only through a properly accredited agent, or through a local merchant firm which takes over their quotation and tenders it in his own name. The invariable stipulation that tenders must be made on Argentine stamped paper and be accompanied by a deposit of 3 per cent. of the tender price, and further requirements, make necessary the final preparation of the tender locally and preclude firms from drawing up the tender in the United Kingdom for presentation in Argentina.

United Kingdom firms who are not represented in Argentina, but who wish to be in a position to submit tenders, may care to arrange with the London office of some Buenos Ayres firm to present their tenders. Names of suitable firms will be furnished on application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W. 1.

Should, however, the appointment of a firm in Argentina to act as their agent be preferred, the Department will be pleased to receive details of the requirements of United Kingdom firms for transmission to the Commercial Secretary for the usual inquiries.—*Board of Trade Journal.*

Outings.—On June 11th, the Designs Section Staff of the G.P.O. Engineering Department went for their sixth annual outing. The party motored to Keston, where it divided up and spent its time, according to taste, in visiting various well-known places in the neighbourhood (they were aided by an admirably drawn-up guide), or rambling over the Common. After tea several photographs of the party were taken, and the return was made by a different route.

On June 4th about 90 of the staff of the electricity department of the Stepney Borough Council held their annual outing, proceeding by char-à-bancs to Hindhead, where they were met by the borough electrical engineer and manager (Mr. Wm. C. P. Tapper, M.I.E.E.), and the chairman of the Electricity Supply Committee (Alderman Major C. R. Attlee, M.A.). Dinner was served at the Sven Thorns Hotel, Mr. Tapper occupying the chair. The party then returned to the open air, and cricket, football, and rambles over the common and to Wagoners' Wells were indulged in. At 5 p.m. an official photograph was taken, and tea was then partaken of. The return journey was made *via* Guildford, Leatherhead, Epsom, and South London.

Gretna Factory to be Sold.—It was stated at a meetin of the Carlisle City Council, on June 14th, by Mr. Partric Kerr, who was a member of a recent deputation to the Government from Gretna, that the War Office had decided to "wash its hands of Gretna," and in all probability the factory would be handed over to the Disposals Board. The construction of the town of Gretna was one of the large enterprises of the Ministry of Munitions, which converted a peat bog, fringing the sea, into a veritable city, with cordite factories employing about 12,000 persons. The buildings and equipment cost £9,181,000, and the cost of working the factory for two years was £12,769,000. Extensive electrical plant and installations for lighting and power were laid down which have been described in our pages.

LIGHTING AND POWER NOTES.

Aberdeen. — OIL FUEL. — Some interesting figures regarding the cost of adapting boilers to oil firing were given recently at a meeting of the Emergency Sub-Committee of the Electricity Committee. It was estimated that the cost of converting one boiler was £700. Four hundred tons of oil per week would be necessary, and a tank with that capacity would have to be installed. The total cost of converting all the boilers and arranging for storage capacity would be at least £12,000.

EXTENSIONS SANCTIONED.—The Town Council has received the consent of the Electricity Commissioners to extend the Corporation generating station by the installation of one 10,000-kW turbo-alternator set, two 36,000-lb. boilers, and the construction of the necessary buildings.

Bath.—YEAR'S WORKING.—The income of the electricity undertaking for the year ended March 31st last was £45,495, as compared with £35,547 in the previous period. Working expenses amounted to £38,045, as against £28,888, leaving a gross balance of £7,450 (£6,659). The payment of capital charges absorbed £9,396, resulting in a net deficit of £1,946, which compares favourably with a loss of £4,120 in 1919-20. It is stated that the increased revenue is due chiefly to increased charges, and partly to increased consumption. The price per unit was raised during the year from 6½d. to 8d., and the number of units sold rose from 1,879,617 to 2,675,592.

Bournemouth.—PRICE INCREASE.—The Bournemouth and Poole Electricity Supply Co. has notified the Council that the following increased scale of charges for power is in operation as from March 25th last:—Up to 1,000 unit per quarter, 3½d. per unit; from 1,000 to 2,000 units 3d. per unit; from 2,000 to 5 000 units 2½d. per unit; from 5,000 to 10,000 units, 2d. per unit, with the standing variation for coal price fluctuations, plus 33⅓ per cent.

Bradford.—MAINS EXTENSIONS.—The Electricity Committee recommends further extensions of electricity mains, &c., at an estimated total cost of £10,000.

Brampton (Cumberland). — PROPOSED ELECTRICITY SCHEME.—At a recent meeting of the Parish Council a proposed scheme for the introduction of electricity was discussed. It was pointed out that the existing gas company was paying it way, but if an electricity company entered the field, neither undertaking would be remunerative. The Council decided, therefore, not to support the scheme financially, although it would place no obstacles in the way of a purely private company.

Canada.—ELECTRICITY FOR FARMERS.—In order to bring electric light and power within reach of a greater number of farmers in Ontario, the Government of that Canadian Province is to grant a bonus of 50 per cent. towards the extension of hydro-electric power transmission lines into new rural areas. Already electric light and power are used in thousands of farm homes throughout Ontario, and one farm in every five has the telephone. —*Lloyd's List.*

Cannock.— BULK SUPPLY SCHEME.—At the last meeting of the Urban District Council it was stated that Mr. Ellis, of Cardiff, the electrical consultant to the authority, had reported upon the proposed agreement with the Wolverhampton Corporation for the supply of electricity in bulk to the Council. The Corporation would lay the cable from Wolverhampton to the Cannock boundary at Wedge's Mills, and the Urban Council would bear the cost of laying the main from the boundary to the proposed transformer station in Queen Street, Cannock. The Urban District Council approved the proposals.

Chester.—LOAN.—The Corporation is making application to the Electricity Commissioners for sanction to borrow £52,000. This is required for carrying out the scheme for taking a bulk supply of electricity from H M. Factory at Queensferry.

Continental.—JUGO-SLAVIA.—The erection of a huge power station at Kostolast, on the Danube, is proposed as a means for supplying electric power to Belgrade, Smederevo, Gotzka, and other towns in Jugo-Slavia.—*British Export Gazette.*

HOLLAND.—As previously foreshadowed a State Commission has now been appointed by Royal Decree to advise the Government in the matter of the supply of electricity throughout Holland. Among the names appear those of representatives of various supply companies and municipal works, and of the President of the Union of the Manufacturers' Association of the Netherlands.

Dover.—OIL FUEL.—As it is estimated by the electrical engineer that oil fuel would raise the station's generating costs by £5,000 a year, the Corporation has decided not to adapt the boilers for oil firing.

YEAR'S WORKING.—The income of the electricity department for the year ended March 31st last was £39,889, as compared with £30.892 in 1919-20. Working expenses totalled £29 996, as against £23,072, leaving a gross surplus of £9 893 (£7.820), equal to 4·9 per cent. on the capital outlay. The net result was a deficit of £5,463, an improvement on the previous year's debtor balance of £6,247.

Eastbourne. — LOANS. — The Finance and General Purposes Committee has recommended application to the Electricity Commissioners for sanction to borrow the following amounts:—£66,000 for electricity extensions; £15,000 for mains, services, transformers, and sub-stations, for three years; and £1,000 excess expenditure incurred in providing a cooling tower at the electricity works.

Electricity District.—NORTH LANCASHIRE AND SOUTH CUMBERLAND SCHEME.—A draft scheme has been prepared for the constitution of a Joint Electricity Authority for North Lancashire, Westmorland, and South Cumberland, and is about to be considered by the various local authorities in the area previous to being placed before the Commissioners on or before July 30th next.

The scheme provides for the generating plant of the five authorised undertakers in the district being transferred to the Joint Electricity Authority, and contains a proposal that 33,000-V main transmission lines should, in the first instance, be constructed between Barrow, Ulverston, Lindale-in-Cartmel, and Lancaster, and from Lindale to Kendal; also that 6.600-V transmission lines should be constructed from Lancaster to Morecambe and Heysham, Lancaster to Galgate, Lindale to Grange, Lindale to Arnside, and Barrow to Dalton.

It is further proposed that the Joint Electricity Authority should establish distributing systems in Arnside, Dalton, Galgate, Grange, Kents Bank, Heysham, Lindale, and Ulverston, and in the areas of other constituent authorities which are prepared to enter into the necessary agreements with the Joint Authority.

The undertaking is likely to effect considerable economy, and make for a cheaper supply of electricity. It is estimated that the completion of the above-mentioned portion of the scheme will result in a saving of coal which alone will more than pay the maintenance, interest and redemption charges on the whole of the transmission lines proposed, and will not only enable the existing undertakers to supply electricity for power and other purposes at prices which they are at present unable to offer, but will also at no very distant date result in a supply for lighting, heating, and power purposes being available in many parts of the district at prices which could not be offered if the supply were generated at small isolated generating stations.

The technical portion of the scheme has been held up to some extent, owing to the negotiations with Messrs. Vickers, Ltd., of Barrow, with regard to the Corporation's taking over the firm's power station not yet having been completed.

It is proposed that the new Authority to be set up shall consist of 30 members, each district having proportionate representation.

Federated Malay States.—ELECTRICITY BOARD.—An Electricity Board has been formed in the Federated Malay States. Generating stations are to be erected near Taiping, Ipoh, Kuala Lumpur, and Seremban. Each town will have its own station, but will be connected with Kuala Lumpur for cases of emergency. It is thought that these plans cannot be brought into operation for some considerable time.—*Reuter's Trade Service* (Singapore).

Glasgow.—WHARF LIGHTING.—A committee of the Glasgow Corporation has resumed consideration of the proposal to substitute electric lighting for the present system of gas lighting at Mecklands Wharf, and, after discussion and inspection of the wharf, agreed to recommend that the work be proceeded with immediately, and that it be remitted to the electrical engineer to obtain and submit offers therefor.

LOAN.—At a meeting of the Electricity Committee, the town clerk made a report regarding the application to the Electricity Commissioners for authority to borrow an additional sum of £1,800,000, and submitted correspondence which he had had with the Commissioners regarding, *inter alia*, the provision to be made for the repayment of the money. The Committee remitted the matter to a sub-committee to make further representations to the Electricity Commissioners regarding the sums to be set aside for sinking fund and depreciation, and with power to adjust those matters with the Commissioners.

IMPROVED EFFICIENCY.—During the year to May 31st, 1921, 187,500,000 units were generated at the various stations of the Corporation electricity department, compared with 176,500,000 in the previous year. Although the number of units generated has increased by over 11 millions, the coal consumed has been reduced by 6,000 tons, the starting of the new power station at Dalmarnock being responsible for the saving. Although definite figures are not yet available, it is stated that the revenue of the department has been increased by approximately £300,000.

Grimsby.—NEW POWERS CONFERRED.—In its new Act, which has recently been passed by Parliament, the Corporation has secured powers to establish showrooms, to lay electric mains in streets not repairable by the Corporation, to increase the maximum charges for electricity, and revise such charges to supply electricity in bulk in certain cases beyond the Corporation's area of supply, and to charge for electrical energy by any method approved by the Electricity Commissioners other than by the actual amounts of electrical energy supplied, or electrical quality contained in such supply.

Hastings.—PRICE INCREASE.—The Town Council has increased the price of electricity for heating and power to 2d. per unit, plus 50 per cent., as from June 30th.

Heston and Isleworth. — LOAN SANCTIONED. — The Council has received the permission of the Electricity Commissioners to borrow £5,232 for mains, and £210 for switchgear.

Hinckley.—Electricity Supply Area.—It has been intimated to the Rural Council by the Electricity Commissioners that for the present the question of provisionally determining an electricity district which would include that area has been postponed.

Lochaber.—Water-Power Bill.—Considerable discussion took place in the House of Commons, on June 9th, on the report stage of the Lochaber Water-Power Bill, which is promoted by a company, with a capital of three million pounds, for the purpose of developing the water power of the River Spey in connection with the production of aluminium. An amendment was moved to safeguard the rights of the counties of Banff, Moray, and Nairn in respect of water power from this river for electricity purposes. Sir W. Mitchell Thompson, on behalf of the Board of Trade, said the production of aluminium and the development of water power were of immense national importance in peace and war. The company's scheme would find work for between 2,000 and 3,000 people. Other interests were amply safeguarded, and he opposed the amendment. The amendment was defeated by 193 votes to 48, and the report stage was concluded.—*Sheffield Daily Telegraph.*

London. — Bethnal Green. — It was stated at a meeting of the Council that, in connection with the schemes for electricity supply in London, Bethnal Green was in a fortunate position. It has no generating station of its own, and the system as laid down on the lines proposed by Sir John Snell, is such that the Council will be able to utilise to the best advantage any bulk supply which may be offered by a joint electricity authority without additional cost.

Holborn.—By the courtesy of the borough surveyor of Holborn and the Metropolitan Electric Supply Co., one or two examples of longitudinal street lighting lanterns (Haydn T. Harrison patents) are to be displayed in use on lamp-posts in Holborn immediately east of Kingsway. It is hoped to keep these in position until after the annual meeting of the I.M.E.A.

Acton.—A failure of the electricity supply occurred in the afternoon of June 10th, causing great inconvenience to local industries and kinemas. The stoppage is stated to have been due to inferior coal supplied to the electricity works and also to the process of conversion to oil fuel being carried out.

Manchuria.—New Works.—The estimates of the South Manchuria Railway Co. for the financial year 1921-22 include the provision of 2,485,961 yen for electrical developments. These include the establishment of an experimental electrical station at Dairen, the erection of a second power station at Dairen, and of a third at Antung, as well as the extension of the Dairen tramway system.

Neath.—Loan.—For the purpose of meeting additional demands for electricity, the Rural District Council has decided to borrow £6,000. It is intended that the works shall be proceeded with during the summer.

Northampton. — Bulk Supplies. — A notice in the *London Gazette* of June 7th announces that the Northampton Electric Light and Power Co., Ltd., is applying to the Electricity Commissioners for permission to give bulk supplies of electricity to the Wellingborough Electric Supply Co., Ltd., and the Rushden and District Electric Supply Co., Ltd., and for authority to carry out the necessary works for this purpose.

Sheffield. — Proposed Price Reduction. — The decreased generating costs per unit brought about by increased efficiency and greater output has enabled the electricity department to keep the price of electricity for lighting at a comparatively low figure. A special Committee on Charges now recommends that reductions be made in the price of energy supplied for power purposes. It is proposed that, after the June quarter, the 150 per cent. increase, placed upon the price of energy supplied previously at less than 2d. per unit, be reduced to 125 per cent. Further reductions will be made as soon as they are justified.

Southwold.— Undertaking Changes Hands.— The undertaking formerly owned by the Coast Development Co. has now been taken over by Edmundson's Electricity Corporation, and it is hoped, by the installation of new plant, to be able to extend the supply to a considerable extent.

Thornton Dale (Yorks.).—Electric Lighting Scheme.—The Pickering Transport Co., of Pickering, is promoting a scheme for the installation of electric lighting plant for Thornton Dale, and it is proposed that when established with the assistance of this company's capital, the undertaking shall be taken over by some special lighting company, or by the local authority. Water power is available, but the company proposes to have two sources of generation. Two thousand £1 shares are to be issued, and a board of directors have been appointed, with an Advisory Committee. Messrs. Walker & Hulton are the engineers, and Mr. F. Pope, of Pickering, is acting as secretary *pro tem.*

Torquay.—Consultant's Report.—The Town Council considered, on June 7th, a report from Mr. E. T. Ruthven Murray, consulting expert, on the possible installation of additional plant on the present site of the power station at Beacon Quay. He states there is no possibility of providing even one additional boiler in the boiler house, nor is it possible to install a boiler in the small space outside the building indicated as a possible site. The only feasible scheme is to increase the output of the existing boilers and to bring into regular use the two boilers which, owing to their position, can only be used with difficulty. The Council had already been advised to convert these two boilers to burn oil fuel, which would increase the output without accentuating the difficulty of coal delivery. He strongly advises the Council to consider forthwith the provision of a supply from another source, with a view to this becoming available in from three to four years' time. Very large economies in production cost would result from the installation of modern plant upon a suitable site, and the increase in output and the improved load factor of the supply which would result from the development of the domestic and power loads would ensure the plant operating under greatly improved conditions.

West Riding.—Electricity Inquiry Costs.—It was stated at a Conference of the West Riding District Councils' Association, held in Leeds on June 7th, that the cost of briefing counsel to put forward the Association's views at the recent electricity inquiry was about £300. It was proposed to recover this amount by a levy of three guineas upon each of the authorities comprising the Association. A delegate from Hunslet protested against this course, and condemned the action of the executive in defending private enterprise as against public ownership. He suggested facetiously that the cost of counsel should be recovered from the Yorkshire E.P. Co. It was ultimately decided to call for a subscription of two guineas from the constituent Councils.

Worcester. — Year's Working.—The total revenue accruing to the Corporation's electricity undertaking during the year ended March 31st last, was £41,179, as compared with £33,116 in 1919-20. The working expenses amounted to £27,236, as against £19,835 in the previous period; the gross profit thus amounted to £13,943, equal to 6·8 per cent. of the capital expended, as compared with £13,281 in the previous year. After payment of loan interest and other capital charges the net result was a profit of £1,657, more than double last year's figure—£762. An interesting feature of the Worcester undertaking is the Powick hydro-electric works. The output from this source rose from 263,020 units in 1919-20 to 913,881 in 1920-21, out of total outputs of 3,000,063 and 3,663,349 units respectively. The overall cost of production is greatly reduced by this means.

The city electrical engineer (Mr. C. M. Shaw, M.I.E.E.) states that, as the result of having suitable stokers, large quantities of pit mound refuse have been employed in maintaining supplies during the coal stoppage, and it has been found possible to resume the full tramway service.

Wrexham.—Bulk Supply.—Reporting that the electricity undertaking had incurred a loss of £2,227 on the past year's working, the Mayor stated, on June 7th, that it was hoped to redeem this within 18 months of the commencement of a bulk supply from the North Wales Power Co. The converting and transforming plant necessary was estimated to cost £100,000. The old plant would be sold, and the money thus obtained would extinguish the outstanding debt.

TRAMWAY AND RAILWAY NOTES.

Birmingham.—Effect of Fare Increase.—The chairman of the Tramways Committee recently stated that since the coal stoppage the weekly earnings had dropped from an average of £33,000 to £31,000. The receipts, although the largest on record, had not come up to the estimates. The effect of the higher fares was to increase the total receipts by £300,000, although there was a falling off in the number of passengers carried of 7,000,000. About £175,000 had been spent during the year in renewing tramway tracks, and it was anticipated that by the end of the year the majority of tramway routes would be in excellent condition.

Bournemouth.—Proposed Increased Charge.—At a meeting of the Town Council, on June 3rd, a letter was read from the Bournemouth and Poole Electricity Supply Co., reminding the Council that the date of revision of the contract under which the company supplies power to the tramways was imminent. The date is July 1st, 1922, and the company asked that an increased charge should be agreed to immediately. The application was not granted.

Bradford.—Track Renewals.—Application is to be made for power to borrow sums for tramway track renewals, and for the construction of cars, as follows:—Permanent way: Manchester Road, £51,490; Cheapside, £5,793; Church Bank, £8,749; Thornton, £14,248; and Birkenshaw, £21,399. Cars: £89,491. Total, £192,170.

Canada.—Battery Railway Car.—The Canadian National Railways are trying out the storage battery type of car on the line running between Trenton and Belleville, Ont., and the officials state that the initial performance of this car gives considerable promise. On the initial run out from Toronto 140·2 miles were run without recharging, in addition to which a demonstration was given of shunting two private cars weighing 208,000 lb. The car is equipped with an Edison battery of 250 cells, type A-12, with a normal capacity of 450 Ah. The actual amount of energy used over 108 miles of this trip was 49 kWh, which works out at 14 Wh per ton mile—considerably less than the figure obtaining in tramway-car operation.—*Electrical News.*

Continental.—SWITZERLAND.—The Federal Council has approved of a loan of 100,000,000 fr. for the electrification of the Federal Railways. The loan will be taken up by a combination of Swiss banks at 6 per cent. for a period of 10 years.

Huddersfield.—NEW REPAIR WAGON.—A number of improvements have been embodied in the new tower wagon lately put into service by the tramway department of the Huddersfield Corporation. The chassis is one of the Karrier Co.'s, of Huddersfield, while the special body has been built by the Corporation. Not only is the working platform on the tower capable of being raised and lowered, but it can be rotated by suitable gearing. The railings fitted to its four sides are also collapsible when required, so that the vehicle can pass under low bridges without lowering the tower. Another feature of the body is that the covered cab contains two rows of seats, so that provision is made for the conveyance of the repairing staff in addition to the driver. There is also a large locker at the rear for the storage of tools and equipment.

London.—L.C.C. TRAMWAYS.—On June 16th, an improved service between the Victoria Embankment and South London was put into operation by the Highways Committee. One improvement effected is the cessation of the arrangement terminating several services at Blackfriars and Savoy Street (Strand). These services will now be connected up and operated as circular services. Another feature of the new arrangement is that fares will be slightly reduced on several routes.

Philippines. — RAILWAY ELECTRIFICATION. — With regard to the plans of the Manila Railroad Co. for the use of electric motive power on its road, the bulletin of the Philippine Government Commercial Agency in New York City states that the electrical power will be developed from the Agno River, in central Luzon, which is believed to possess a potential capacity of from 12,000 to 15,000 h.p. A thorough topographical survey of the entire water-power site is being undertaken, and early reports of the survey would seem strongly to point to the feasibility of the project.—*Electrical Review* (Chicago).

Sunderland.—YEAR'S WORKING.—The report of the general manager of the Corporation tramway department for the year ended March 31st last records a total income from all sources of £158,165, as against £149,442 in the previous year. Working expenses amounted to £136,668, as compared with £108,079, leaving a gross profit of £21,497 (£41,363). After payment of capital charges, a net profit of £8,017 was carried to appropriation account. This compares with a sum of £29,181 transferred in the previous year. The number of car-miles run increased from 1,597,525 to 1,647,618.

NEW TRACK.—The Town Council has decided to spend £6,768 in order to double the track in Ryhope Road between Spelter Works Road and Grangetown terminus. Another £2,550 will be expended on making an additional entrance to the Wheat Sheaf Car Depôt *via* Dundas Street to North Bridge Street. Other expenses connected with the latter item—such as paving, &c.—will cost £1,400. On the question of economy these matters were referred to the Finance Committee of the Corporation, which has now reported that it considers the works of vital importance and urgency.

Swansea.—TRACK REPAIRS.—The general manager of the Swansea Tramways Co., having called the attention of the Corporation Tramways Committee to the large sums being paid for repairs to the permanent ways, the borough engineer, Mr. J. R. Heath, has been instructed to make the best arrangement possible for an alteration of the working of the staff and the bringing about of a reduction. Mr. Heath reported that the tramway track was in fair condition considering that it was 16 or 18 years old.

TELEGRAPH AND TELEPHONE NOTES.

Australia.—NEW WIRELESS STATION.—A wireless telegraph receiving station, fitted with apparatus capable of receiving messages over a distance of 12,500 miles, has been erected at the Observatory at Perth, W.A., says *The Times*.

The number of radio stations operated and controlled in the Commonwealth was stated by the Minister of Defence recently to be 20, exclusive of naval stations at Garden Island, Jervis Bay (N.S.W.), and Williamstown. The most powerful stations were those at Perth and Sydney, which had a radius of action of 2,000 miles normally. The Port Darwin station had a radius of 600 miles during daylight. The other stations in the tropical areas were at Broome, Wyndham, Port Moresby, Thursday Island, and Cooktown, with similar radii to that of Darwin station; Misima (300 miles), Samarai (400 miles), and Townsville (1,500 miles). In addition to the stations in the Commonwealth, there were eight under the jurisdiction of the Administrator of the New Guinea territory.

TELEPHONE METERS.—The Postmaster-General (Mr. Wise) is in favour of attaching meters to telephone circuits provided that one can be obtained that will operate reliably. The Noble meter is being tested at the State engineer's office at the Sydney G.P.O., but the department has not decided to adopt it

Canada.—NEW WIRELESS STATIONS.—In order that Northern Manitoba may be brought into direct communication with the other part of the province, it has been recommended that 12 wireless stations be immediately installed, at a cost of £11,000. One big station has already been built at the Pas, says *The Times*.

India.—SHIPS' WIRELESS.—The Government of India is discussing with various public authorities the desirability of compelling shipping of practically all classes to install wireless telegraph apparatus. According to *The Times Trade Supplement*, it is not improbable that sailing ships will for the present be excluded from the legislation which is being drawn up, as will also small steamers engaged in "smooth-water" voyages.

Magnetic Storms.—The sunspots which accompanied the magnetic disturbances in May are now impotent specks, but last week the observatory at Skansen, Stockholm, announced the discovery of new spots on the sun, and electrical disturbances, followed by violent thunderstorms, occurred in Switzerland on June 5th and 6th.

South America.—FRENCH CONCESSION.—We are informed by the Department of Overseas Trade that the French *Vie Financière* reports that the Compagnie Générale de T.S.F. has concluded a contract for a period of 30 years with the Government of Ecuador for the working of the telephones, telegraphs, and wireless service in that State. The Government of Ecuador will pay the company an annual subsidy of 430,000 sucres (about 1,200,000 fr.), which will be increased in the event of any extension of the system. The company will deduct from the gross receipts the sums necessary for the working of the lines, for the payment of interest on the capital invested in the concern, and for the sinking fund. The State will have a share in the net profits. The telephonic apparatus will be automatic and constructed on a system which has been perfected by French experts. The telegraphic and wireless apparatus will also be on French models. The engineer who is in charge of the enterprise in Ecuador, considers that it will be possible to find in the country itself almost the whole of the necessary staff, as there are a number of excellent engineers in the Republic.

The Telegraph Service.—NEW CONTINENTAL CIRCUIT.—A direct telegraph circuit between London and Prague has been opened for traffic.

The Telephone Service.—LONDON-PARIS CIRCUIT.—In order to stop exchange speculation between Paris, London, and other capitals, the *Matin* is urging the authorities to come to an agreement with the British and other Governments to put an end to the monopolising of international telephone lines whereby exchange speculators are able to make quick deals when exchange rates in Paris and London show a wide difference in price. The *Matin* urges that the same rate should prevail at the same moment in both cities. The method of operation of the speculators, the paper adds, is to put in as many calls as possible every day, thus keeping the lines to themselves during the day.—*Financial Times*.

United States.—NEW CHICAGO POST OFFICE.—The new Post Office building at Chicago, the construction of which has just been begun, will have a roof upon which mail aeroplanes will be able to alight and to "take off." The building will also be connected by miniature underground electric railways with all the principal railway termini in the city, and by means of moving bands mail sacks will be carried all over the building.—*The Times*.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Australia. — MELBOURNE. — August 10th. Victorian Railways. 250 core-type impedance bonds for power signalling, with a capacity of 1,000 amperes per rail; also 50 miles of solid insulated copper wire, No. 14 Brown & Sharpe gauge, and 50 miles of solid insulated copper wire, 16 standard gauge.

July 27th. Victorian Railways. Incandescent lamps for electric car lighting: 24,000 metal filament, 46 W, 116 V; 4,000 carbon filament, 32 W, 140 V. 5-h.p. electric motor, controller and resistances, or, alternatively, 5-h.p. electric motor and equipment.*

August 31st. Electricity Commissioners. Steelwork for power station buildings, roof covering, &c.; water-tube boilers, stokers, fans, &c.; platforms and ladders, steel chimneys, flues and dampers, sooting and dust extraction equipment, ash handling plant. (June 3rd.)

August 17th. 3,000 sets of renewals for caustic soda primary cells.

August 30th. Board of Works. Four electrical centrifugal pumps, each with a capacity of twelve million gallons daily.

September 7th. Victorian Railways. Sixteen sets of air-brake equipment, 450 to 600 V, d.c., for single-deck tramcars.—*Reuter's Trade Service* (Melbourne).

TASMANIA.—P.M.G.'s Department. July 11th. Switchboard material (Schedule T. 317). (June 3rd.)

Shire of Hampden (Victoria).—August 17th. Boiler-house plant, steam-driven electricity generators, transformers, meters, switchgear, cables, poles. Specifications from Mr. H C. Ingleton, Shire Hall, Camperdown, Victoria.—*Tenders.*

Bury.—June 22nd. Installation of wires and fittings for the electric lighting from the public supply of 92 houses in the Walmersley district. Specification, Mr. S. J. Watson, Electricity Works, Bury.

Belgium.—June 29th. The Belgian Post and Telegraph authorities at La Salle, Madeleine, Brussels, call for a quantity of cable heads. Copies of the specification (Cahier des Charges Special No. 618) can be obtained from the above address for 90 centimes.

Edinburgh.—June 22nd. Corporation. Electric lighting installations for houses under the Gorgie housing scheme. Specifications from Burgh Engineer.

July 11th. Electricity Supply Department. H.p. steam pipes and valves. Specification 33. (See this issue.)

Jugo-Slavia.—June 29th. Minister of Posts and Telegraphs. 18,000 kg. of g.i. wire, 80,000 curved carriers, and 80,000 porcelain insulators.*

Kirk Sandall.—June 22nd. Installation of electric light at the temporary Council School. Specifications from West Riding Education Architect, County Hall, Wakefield.

Llandaff and Dinas Powis.—June 22nd. Rural District Council. E.h.p. feeder, with switchgear sub-station equipment complete. (June 10th.)

London.—Islington.—July 4th. Electricity Committee. H.p. switchgear, flame carbons. (June 3rd.)

L.C.C.—July 11th. One 8,000-kW steam turbo-alternator and exciter, condensing plant, &c.; seven 1,000-kW rotary converters, static transformers and accessories. (June 10th.)

Manchester.—June 21st. Education Committee. Electric lighting installations at Plymouth Grove and Upper Jackson Street Municipal Schools. Specifications, &c., from the Education Offices, Deansgate, Manchester.

June 21st. Tramways Committee. Points, tongues, crossings, and hardened-steel centres. From Mr. J. M. McElroy, general manager, Corporation Tramways, 55, Piccadilly, Manchester.

June 28th. Electricity Committee. Supply of cable requirements during six months ending December 31st, 1921. Mr. F. E. Hughes, Secretary, Electricity Department, Town Hall, Manchester.

June 28th. Electricity Department. 27,000 yards weldless-steel spigot and socket tubes. (See this issue.)

New Zealand.—Wellington.—June 28th. Public Works Department. Ten s.p. oil-filled transformers for the conversion of three-phase energy at 50 cycles, the voltage ratio being 50,000/11,000, for Waikato power scheme.*

June 28th. Supply and delivery at Lyttelton of two 50-kVA, two 100-kVA, and two 200-kVA condensers in connection with the Lake Coleridge electric power supply (Section 116).*

July 31st. Wairoa Electric Power Board. (*a*) Transformers, four 200-kVA, 11,000/1,900 single-phase units; (*b*) Insulators, 11,000 V and 3,000 V; (*c*) Air-break switches, 11,000 V and 3,000 V; (*d*) Fuses, 11,000 V and 3,000 V; (*e*) Lightning arresters and choke coils, 11,000 V and 3,000 V; (*f*) Accessories as per schedule. Tenders to the office of Messrs. Hay & Vickerman, Wellington.*

August 9th. Public Works Department. Suspension-type porcelain insulators for the Waikato power scheme.*

Pontypridd.—Board of Guardians. June 23rd. Three months' supply of electrical material. Mr. Wm. Spickett, Clerk, Union Offices, Pontypridd.

South Africa.—July 5th. Electrification of Capetown-Simonstown and Durban-Maritzburg railway lines.

Transvaal.—Rand Water Board. September 9th. Erection of a complete installation of mechanical or other filters capable of filtering 5½ million gallons of water per 24 hours at the Vereeniging main pumping Station (Contract No. 232). Copies of the contract documents may be obtained from the Chief Engineer, Rand Water Board, Johannesburg, upon a deposit of three guineas.*

Barberton.—July 29th. Municipal Council. Plant in connection with the proposed scheme for the supply of electricity:—Two steam boilers, two 75-kW steam-driven alternators, switchboard, and instruments, steel chimney piping, feed pumps, cables, &c., steel poles, conductors, &c., transformers, house service meters, &c. Specifications, £2 2s., from Prof. W. Buchanan, 75, Louis Botha Avenue, Johannesburg.

Sudan.—June 30th. Sudan Government. Pumping machinery, consisting of Diesel or semi-Diesel engines and direct-coupled centrifugal pumps, capable of lifting 1,200 litres of water per second against a static head varying between 2·5 and 8 metres. Machinery must be delivered at Khartoum North by February 28th, 1922. Specifications, drawings, and conditions of tender may be seen at the office of the Sudan Agent, War Office, Cairo, Egypt. Tenders to Superintending Engineer, Department of Agriculture, Sudan Government, Atbara.—*Reuter's Trade Service.*

Trimdon.—June 11th. Electric light extension from Trimdon Grange to Trimdon Village, including the lighting of Trimdon Village with electricity. Specification, Mr. T. W. Wilkinson, Clerk to the Council, 24, South View, Trimdon Grange, S.O. Deposit, £2 2s. (returnable).

Uruguay.—Monte Video.—August 18th. State Electricity Works. Steel petroleum tank, Worthington duplex steam pump for oil, 250 metres steel tubing.*

* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

Australia.—Generating plant for the Morwell power scheme. The *Manchester Guardian* says the accepted contract of Messrs. Metropolitan-Vickers Electrical Co., Ltd., is for five 12,500-kW turbo-alternators; the surface condensers will be made in Victoria, while an American firm will supply the switchgear and transformers; delivery of the first set has been promised in four months, with completion in 17 months.

Bedford.—Maintenance of school lighting for six months for Bedford Education Committee, Gollings & Ayres.

Belgium.—Seven concerns, among them three British—the British Insulated & Helsby Cables, Ltd., W. T. Henley's Telegraph Works Co., Ltd., and the Metropolitan-Vickers Electrical Co., Ltd., last week submitted tenders to the Belgian Post and Telegraph authorities in Brussels for the supply of a quantity of telephone cable. The tenders ranged from 365,926 fr. to 1,334,644 fr., the lowest being that of the Société Electricité et Mécanique, of Brussels.

Bradford.—The Electricity Committee recommends the purchase from the Ministry of Munitions of the electrical plant, switchgear and cables, installed at the Phœnix Dynamo Works of the English Electric Co., Ltd., at Thornbury, Bradford. The price is £2,370.

Electricity Committee:—

John Spencer, Ltd.—Supply of steam piping for works, Valley Road, £213.
Clay Cross Co., Ltd.—Cast-iron piping, for cooling towers, £730.

Tramways Committee:—

Cammell, Laird & Co., Ltd.—75 Siemens open-hearth nickel chrome steel axles, £641.
Thermit, Ltd.—500 Thermit welding portions, at 19s. 6d. each, plus 25 per cent.
Taylor & Parsons, Ltd.—48 dozen Dreadnought files, at 54s. per dozen.

Doncaster.—Electricity Committee. Circulating-water piping at the generating station—Brightside Foundry and Engineering Co., Ltd., £1,289.

Manchester.—Electricity Committee. Accepted. Park Royal Engineering Works, Ltd., for the supply of high-pressure cubicles (sub-station) for 12 months.

Staffordshire, Wolverhampton and Dudley Joint Committee for Tuberculosis.—We understand that while the tenders mentioned under this heading in our last issue have been considered, it is not correct to say that they have been accepted. The installation concerned (Prestwood Sanatorium) will be of exceptional interest, owing to the use of water power for generating electricity for lighting, power, and heating the water used in and about the institution. The scheme has been designed throughout by Messrs. Henry Lea & Son, of Birmingham.

FORTHCOMING EVENTS.

Royal Institution of Great Britain.—Friday, June 17th. At Albemarle Street, W. At 9 p.m. Lecture on "Chemical Combination and the Structure of the Molecule," by Sir J. J. Thomson, F.R.S.

Batti-Wallahs' Society.—Monday, June 20th. At the Holborn Restaurant, W.C. At 1 p.m. Last luncheon of the session.

Faraday Society.—Wednesday, June 22nd. At Burlington House, Piccadilly, W. At 8 p.m. Ordinary scientific meeting.

Physical Society of London.—Friday, June 24th. At the Imperial College of Science, South Kensington. At 5 p.m. Ordinary meeting.

Report on the Electrical Cable Industry.—A report of a Sub-committee to the Standing Committee on Trusts, just issued, deals with the electrical cable industry (Cmd. 1332. Price 1d.). We are unable to deal with it in this issue; but, briefly, the report states that the prosperity of the industry is largely due to the Cable Makers' Association, which, by its organisation and research, initiated and has maintained a high standard of quality, thus securing the confidence of buyers both in this country and abroad. There is no evidence that the Association has acted unreasonably, and there was a marked absence of hostility towards the Association on the part both of users and of non-associated firms. The Sub-committee finds that while non-associated firms are able to produce equally reliable cables at prices about 10 per cent. lower than those of associated firms, the largest purchasers, as a rule, are content to pay the additional price as in the nature of an insurance against breakdown and a guarantee of durability.

RAILWAY ELECTRIFICATION IN CENTRAL EUROPE.

By S. PARKER SMITH, D.Sc.

In the issue of March 5th, 1921, of the *Electric Railway Journal*, an article by E. C. Zehme, a Privatdozent in Berlin, appeared under the above heading.* In this article the following statements were made :—

It has been customary to consider Germany, Switzerland, Austria, and Sweden, as the advocates of the single-phase system, but they are not so to-day. Only Switzerland and Austria are extending their single-phase roads at present, whereas no definite conclusions have as yet been reached as to the standard system in Germany, Sweden, Norway, and Holland, and even in Italy.

Recently doubts have been advanced from several sides as to the practicability of the single-phase system for the main railroads of Germany. . . . Nevertheless, the authorities still manifest a preference for the single-phase system, and have decided to call an International Congress this year in Germany to go over the whole matter, presumably hoping that the present view-point of the Prussian State Railways with regard to the system will be justified.

The Swedish State Railways plan to electrify additional lines, principally in the South, and primarily for passenger traffic. Here the question of system has again been studied very carefully. . . . Although the single-phase system is estimated to be somewhat more economical than the other, the difference is small, and is being considered in connection with the inductive disturbances in telegraph and telephone lines caused by the alternating-current operation. A special commission on this subject has studied the phenomena carefully, together with the remedy for the trouble, and has presented a long report. This is unfavourable to the single-phase system.

That these allegations do not appear to be well founded, as far as Germany and Sweden are concerned, would appear from the following refutations :—

An official announcement appears in the *Deutsche Allgemeine Zeitung* of May 14th, 1921, of which a translation is given below :—

THE ELECTRIFICATION OF RAILWAYS.

In the American technical paper *Electric Railway Journal*, a Privatdozent, E. C. Zehme, of Berlin, published an article entitled "Electrification in Central Europe," in which, among other things, it was stated that Germany had not yet finally decided what system to adopt for electric railways, and, in order to settle this question, intended to call shortly an international congress. These statements are not correct. The German National Railway Administration has, like the railway administrations of the several German States before it, as far as electrified lines are concerned, always regarded the simple single-phase current as the only system to be considered for its long-distance railways, and has never, not even temporarily, deviated from this standpoint. As all the existing long distance railways of the German National Railway Administration are operated with single-phase current, so also the single-phase current alone has been considered for the electrification of further sections. Under these circumstances, there is also no object in calling a congress to discuss the question of the systems. Though in February last there was an exchange of opinions between the Railway Administration and well-known outside experts on questions of electrification, this was chiefly in connection with the question of supply.

The following statement was also supplied by Mr. F. Ofverholm, the chief electrical engineer of the Swedish State Railways :—

I have now got the number of March 5th, 1921, of the *Electric Railway Journal*, and found the article by Mr. Zehme. This article is not correct at all. First, the total length of the electrified railroads in Sweden is now 260 miles, out of which only 20 miles is direct current, and the other 240 all single-phase.

Then Mr. Zehme states that the report about the disturbances in telegraph and telephone lines was unfavourable for single-phase. I have sent you that report with letter of September 3rd, 1920, and you can judge for yourself. I think you will find the contrary. At the end of this year we shall have 400 miles of single-phase roads, and the old 20 miles of d.c. roads in this country. The statement that we are not extending our single-phase roads is, therefore, surely not correct.

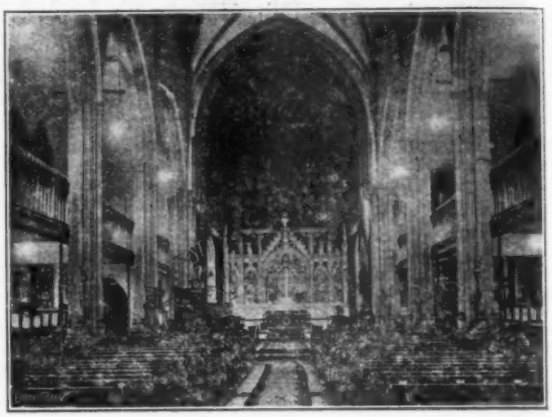
In these days when the "battle of the systems" is so much to the forefront, misleading statements such as those quoted from Herr Zehme's article should be carefully avoided. The issues at stake are far too important for all countries, to allow such mis-statements to pass uncorrected.

* The article was quoted in the ELECTRICAL REVIEW of May 6th, 1921, p. 574.

NOTES.

Luncheon to Mr. Hughes.—The Rt. Hon. W. M. Hughes, the Prime Minister of the Commonwealth of Australia, will be the chief guest at a public luncheon to be given in his honour by the British Empire Producers' Organisation, at the Hotel Victoria, on Wednesday, the 22nd inst. The Chairman of Council of the Organisation, Mr. Ben H. Morgan, will take the chair. Early application for tickets, price 10s. 6d. each, should be made to the Secretary, 5, Old Queen Street, S.W.1.

Church Lighting.—The lighting of a church presents to the illuminating engineer a problem which is difficult on account of various reasons. In an edifice of this nature, special care must be taken not to offend the susceptibilities of those who look with some apprehension upon the advent of "modernism" in connection with religion. It is therefore necessary to choose a system which combines efficiency with unobtrusiveness. Messrs. W. T. Henley's Telegraph Works Co., Ltd., have sent us photographs of two installations which Messrs. Stanley Gaynor & Co., of Cardiff, have recently completed at Bath, using the Henley wiring system and Holophane fittings. The above illustration shows the lighting of St. Saviour's Church, Bath, which, as far as the exigencies of reproduction permit, shows very clearly the effectiveness of the work.



London Electricity Statistics.—The London County Council Electricity Supply Returns (1918-20), just published, give some interesting statistics.

The summary of units sold by the undertakings in the Administrative County of London affords a record of the progress of these concerns. We find that (taking round figures) for 1919 the municipal undertakings sold 168 million against the companies' 244 million kWh. As regards the increase of units sold from 1913 to 1919, among the municipalities Woolwich shows the biggest increase, being 209 per cent.; Fulham comes next with 76 per cent., then Stepney with 75 per cent. Among the companies, the South Metropolitan Co. tops the list with 135 per cent. increase, the County of London Co. coming next with 65 per cent.

Coming to the extra-London area, the number of units sold by the municipalities in 1919 was 117 million, and by the companies 72 million kWh.

If we take the whole of the area of Greater London, we find that the units sold by the municipal undertakings were 285 million, and the companies' sale 312 million kWh.

As regards the general progress in the Administrative County area, the total of units sold by all undertakings shows a good upward tendency. In 1907 the total units were 185 millions, rising to 319 millions in 1913, and to 412 million kWh in 1912. We look, however, to see this rise assume a precipitous gradient in the near future when the supply undertakers of London are given full scope for their ambitions and the interlinkers are allowed to work out in reality those dazzling dreams now only on paper.

The Conjoint Board of Scientific Societies.—The fourth report of the Board shows that it has received evidence that scientific investigation is being seriously hampered by the heavy cost involved in the publication of results. An exceptional number of papers is being communicated to the scientific societies, including many held up during the war, while the resources of the societies which have not increased, are insufficient, at present prices, to publish even the normal pre-war number. The country is thus in danger of being seriously handicapped at a time when the re-habilitation of industry is in most serious need of scientific assistance. Much of the report is occupied with a short abstract of the third report of the Committee on the Water Power of the Empire. It is shown that too little is being done to ascertain the total resources, or to secure uniformity in investigation and record. It is urged that steps should be taken to convene an Imperial Water Power Conference in London, at which various Dominions and the dependencies of the Empire should be represented. The outcome of such a conference might well be the creation of an Imperial Water Power Board, with extensive powers to carry out a comprehensive policy for stimulating, co-ordinating and, where necessary, assisting development throughout the Empire.

X-Ray Photographic Exhibition.—An exhibition of X-ray photographs has been opened at the premises of the Royal Photographic Society; it has been arranged by the Röntgen Society, and will remain open for the whole of this month.

Automatic Hydro-electric Plant.—In a recent article the *Electrical World* gave some interesting particulars of the working of an automatic hydro-electric plant at Cedar Rapids, Iowa. This plant, owned by the Iowa Railway and Light Co., has been in operation for three-and-a-half years, and its success has been so marked, and it is so much more reliable than hand-controlled stations, that the future policy of the company will be to equip all present plant with automatic control, and all new developments will be automatic. It is estimated that from $3,600 to $4,800 has been saved on labour charges alone. The station has an output of about 7,500,000 kWh per year, and the average annual maintenance and operation charge has only been $178, resulting in a cost for delivered power of '45 cent per kWh. With the article appears a table of particulars of a number of automatically-operated stations which have been built or are in course of construction. One of these, completed in 1919, is that of the Ontario (Cal.) Power Co. This has a capacity of 500 kVA, and power is generated at a pressure of 11,500 V. In this the master starting element is a remote hand-operated switch. The largest plant of this kind, which is being erected by the Washington Power Co., consists of a 12,750-kVA synchronous generator working at a pressure of 4,200 V. This will also be put into operation by a remote hand-operated master switch.

Economy in Collecting Accounts.—According to Mr. J. R. Kaiserman, manager of the Livingston branch of the Montana Power Co., an appreciable saving of time and expense is made if the meter reader makes out the bill and leaves it with the consumer when he calls to read the meter. The system has been in operation for three years with satisfactory results, the average saving being estimated at 2½d. per month per consumer. Details of the system are given in the *Electrical World* of May 28th, 1921.

Melting Non-ferrous Metals.—A correspondent of *Chemical and Metallurgical Engineering* complains that the author of a recently-published article upon the comparative merits of gas-, coke-, coal-, oil- and electrically-heated furnaces chose an example of very indifferent character as a representative electrically-heated furnace plant. The author expressed his satisfaction at finding a gas furnace which would melt a 1,100-lb. charge of brass in 42 minutes the fuel cost being 32·2 c. per 100 lb. The writer of the letter points out, however, that he knows of half-a-dozen plants in which 2,000-lb. charges are electrically melted in less than forty minutes and at a cost of less than 17 c. for power.

Electrically-Propelled Ships.—The British Admiralty, the *Daily Mail* understands, is considering the adoption of electric propulsion as an experiment in one of the four new £9,000,000 battleships, the plans for which are now being decided.

Electron Tubes in Heavy-Power Service.—According to Dr. Albert W. Hull, of the research laboratory, General Electric Co., before the A.I.E.E., at its annual meeting in New York on May 20th, "One year will see these tubes [electron tubes] in use as kenetron rectifiers for series arc lighting. Five years will see them in sub-stations, replacing rotary converters. In 10 years they will be on electric locomotives, either as rectifiers, allowing the use of direct-current motors, or as variable-frequency alternators, taking their power from a high-tension, direct-current trolley line. Twenty years will see direct-current transmission lines fed through transformers and kenetrons, at any convenient point by alternators of any frequency, and tapped by the same tubes acting as magnetron alternators, as some equivalent pliotron or combination alternator."

Dr. Hull described the new vacuum tube, which is called "magnetron" because the valve control is accomplished by means of a magnetic field. Although the magnetron has been used only for weak currents, he showed a magnetron tube with an anode 4 in. (10 cm.) in diameter and 12 in. (30 cm.) long, which had been operated at 5 kW output. With larger filaments and water cooling, these tubes would be capable of handling hundreds of amperes.—*Electrical World.*

The Battl-Wallahs' Society.—Mr. A. J. Greenly, Honorary Entertainment Secretary, has addressed a letter to the members with regard to the luncheon on June 20th, at the Holborn Restaurant, at 1 o'clock, which marks the close of the luncheons until after the summer holidays. There is to be no speaker; this meeting is reserved for society matters. He invites members to come without fail, and to offer concrete suggestions for furthering the objects of the Society.

Cast-Iron Research.—The Secretary of the Department of Scientific and Industrial Research announces that a licence has been issued by the Board of Trade to the British Cast-Iron Research Association, the secretary of which is Mr. Thomas Vickers, Central House, New Street, Birmingham.

Fire.—Damage amounting to several thousands of pounds was caused by a fire which broke out at the works of the Cable Accessories, Ltd., Dudley Port, recently. Three fire brigades were requisitioned to subdue the outbreak. The damage is covered by insurance.

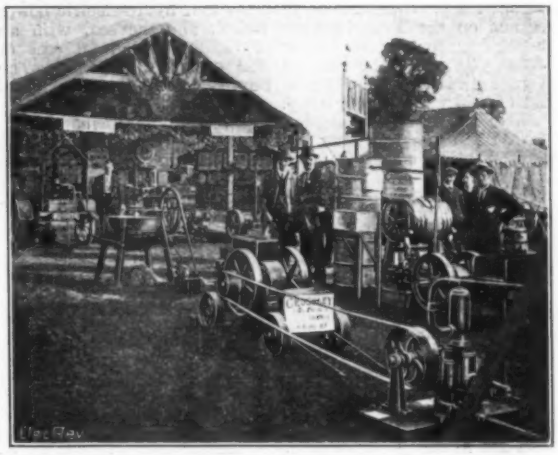
The Theory of Relativity.—On Thursday last week, at the University of Manchester, before an audience of about 1,000 persons, Prof. Albert Einstein gave his first address in this country on his theory of relativity. Before the lecture, the honorary degree of Doctor of Science was conferred on him.—*The Times.*

On Monday evening Prof. Einstein lectured before a very large audience at King's College, London.

Service Notes.—Further ex-officers have been posted to the Defence Force in connection with electric light companies and motor companies. Warrant Telegraphist R. W. Craig has been posted to the *Vulcan*, depôt ship for submarines at Chatham, from the 25th inst. Warrant Electrician P. J. Freeman has been appointed to the *Vernon*, torpedo school ship at Portsmouth, from the 4th inst. Recruiting for the various electrical departments of the Navy and Army is doing very well at the moment, the state of the labour market being favourable to enlistments, as well as the general better conditions of service and better pay in both Army and Navy.

Electrical Farming in Russia.—Strenuous efforts are now being directed to the improvement of Russia's agricultural industries, and one of the latest proposed expedients is the mobilisation for agricultural purposes of the portable electrical field sets that can be spared, it is hoped, by the military department now that the calls on the Army are neither so exacting nor extensive as in the immediately preceding years. These portable sets which were used for searchlights, wireless telegraphy, &c., and which have low-voltage dynamos, will be put to work in the fields in the course of this summer. They may be said to weigh on their carriages close on a ton, and will be able to serve a number of peasant allotments, simultaneously driving thrashers, cutters, and other small machines in the various districts which they will visit. When the season's work is over they will be returned to the War Department. Thousands of them have been made, and it is asserted that 70 per cent. of them are in good condition for farming purposes.

Electricity in Farming.—The accompanying illustration shows the exhibit of Messrs. J. Bastin's Electrical Works at the recent Oxfordshire Agricultural Show, held at Banbury, and



described in our issue of June 3rd. The photograph discloses a large number of applications which can be found for electricity in agricultural work.

Water Power in Greece.—According to the United States Consul-General at Athens, a Swiss engineer has been employed by the Greek Government to investigate the water power in the State of Macedonia, and he has made an interesting report on the subject after a study of the falls of the rivers of Kladovo, Vodena, Niaoussa, lower Aliakmon, and high Aliakmon. Special tables have been prepared showing the estimated power of the falls of Kladovo to be 17,500 h.p.; those of Edessis, 26,000 h.p.; of Niaoussa, 22,000 h.p.; those of the lower Aliakmon, 143,000 h.p.; and those of high Aliakmon as 143,000 h.p. The total water power available from these falls is estimated at about 350,000 h.p.

It is estimated that the exploitation of the falls mentioned above will produce annually about 120,000,000 kWh. The production of electricity from the falls of western Macedonia would be sufficient not only for the motive power and lighting of the three cities of Athens, Piræus, and Saloniki, but also for the motive power of the Larissa railway.

The consumption of electrical energy at Athens and Piræus is about 40,000,000 kWh annually, and at Saloniki 9,000,000 kWh. The plants for the development of the waterfalls would cost approximately between 160,000,000 and 180,000,000 drachmas (£6,000,000 to £7,000,000). On the basis of this expenditure, a kWh would cost from 12 to 13 lepta (1¼d.). As Greece is dependent upon the importation of coal for a large part of its fuel supply, the employment of its water power is of vital importance in the development of the national industries.

The Water Power Resources of Ireland.—A great deal of attention has been directed in Ireland to the newly issued report of the Board of Trade Sub-Committee on water-power resources in that country. Sir John P. Griffith was chairman of the sub-committee, which recommends development as urgent, and states that the most effective and economical method is to construct the necessary works in the channels of the rivers, and not to attempt to seek high falls by the construction of costly head race channels. Detailed investigations were made of the Lower Bann, the Lower Shannon, the Lower Erne, and the Liffey. The investigations show that considerable power is available in these rivers, as well as in the high level lakes in Donegal, Connemara, Kerry, and Wicklow. The development of tidal power should be examined by a Special Commission.

In the Liffey, Dublin City and its adjoining district have at disposal water-power sufficient to provide electricity in excess of that at present supplied by the seven existing generating stations, and there is also a considerable margin of power for future extensions.

The engineers who conducted investigations in respect of the Liffey, Messrs. J. W. Griffith and H. H. Jeffcott, state that six hydro-electric power houses on the river are proposed, the principal sites being at Poulaphouca, Golden Falls, and Salmon Leap. Automatically controlled power stations are proposed at Lockstown, Cloghleagh, and Connell Ford. The installed plant will have a total capacity of 29,600 e.h.p., and the estimated cost of works and plant is £920,000 at present-day prices. The estimated cost is £31 per e.h.p. installed, or £111 per average e.h.p. developed during a year at the power sites. The cost of transmission to Dublin, including transformers, is estimated at £293,000.

Mr. Theodore Stevens, giving evidence before the Sub-committee, dealt with the river Erne, and proposed the construction of a canal or head race over 5¼ miles long to carry the water to a power station with a head of 125 feet.

Mr. Stevens's proposals include the erection of four hydro-electric power stations on the river Shannon between Killaloe and Limerick with an installed electrical horse power of 65,900, at a total cost at current prices of £2,834,000, or at the rate of £43 per installed e.h.p. The average annual output obtainable would be 52,500 e.h.p. at a capital cost of £54 per average e.h.p. Similarly he proposes four hydro-electric power stations on the Erne between Beleek and the sea, with an installed electric horse power of 71,300, at a total cost of £2,060,000, or at the rate of £29 per installed e.h.p. The average annual output would be 45,500 e.h.p., at a capital cost of £46 per average e.h.p.

As to the river Bann, Mr. Charles Meik proposes the removal of Toome weir, the dredging of the bar at Toome, and the formation of an improved channel from Lough Neagh to Lough Beg. Total estimated cost £360,000. All the power available could be used by the milling interest of the district.

INSTITUTION NOTES.

Institution of Electrical Engineers. — NORTH-WESTERN CENTRE.—The annual report of the Committee for the session 1920-21 states that eleven general meetings and one lecture were held, at which the average attendance was 110. The membership as at May 25th, 1921, was 1,214, as compared with 984 in the previous year. A memorandum signed by 56 members requests the institution of informal meetings, and the matter is under consideration. The Preston Sub-Section has decided to discontinue its activities, as its meetings have overlapped those of the English Electric Engineering Society, which already embodies most members of the Sub-Section. The newly-elected chairman is Ald. W. Walker, and the vice-chairmen are Messrs. A. S. Barnard and G. A. Juhlin.

Students' Section.—The Committee of the Students' Section of the Centre reports that the average attendance at seven meetings was 40.

Liverpool Sub-Centre.—The Committee reports an increased membership of 73, bringing the total up to 367. Mr. G. H. Nisbett has been elected chairman for the ensuing session.

Institution of Civil Engineers.—A very fine programme has been arranged for the Engineering Conference which is being held on June 28th, 29th and 30th and July 1st under the presidency of Mr. John A. Brodie. On June 28th, Sir George T. Beilby, F.R.S., will deliver the 27th James Forrest Lecture on "Fuel Problems of the Future." Most of the discussions will be of more or less interest to electrical engineers, but mention may be made of those in Section VII, Electricity Works and Power Transmission, presided over by Sir John Snell. On June 29th, Mr. R. O. Kapp will open a discussion on "Low Power-Factor"; Mr. J. Dalziel will deal with "Battery Locomotives" on June 30th; and discussions will take place on July 1st on "The Economic Limits of Distribution from Coal-fired Stations," "Low-voltage Overhead Distribution" (Mr. B. Welbourn) and "The Mechanical Advantages of Electric Locomotives compared with Steam" (Sir Vincent L. Raven, K.B.E.). Among many visits which have been arranged are several to power stations and electrical works. On June 29th Sir Alexander B. W. Kennedy, F.R.S., will exhibit lantern slides reproduced from photographs taken by him of the war area in France and Flanders.

Royal Society of Arts.—The Albert Medal of the Society for 1921 has been awarded by the Council to Prof. John Ambrose Fleming, M.A., D.Sc., F.R.S., in recognition of his many valuable contributions to electrical science and its applications, and especially of his original invention of the thermionic valve, now so largely employed in wireless telegraphy and for other purposes.

American Institute of Electrical Engineers.—At the annual meeting on May 20th, Dr. W. McClellan was elected president for the ensuing year. The vice-presidents were Messrs. W. A. Hall, N. W. Storer, W. A. Del Mar, C. G. Adsit, J. C. Parker, F. W. Springer, H. W. Eales, R. Sibley, O. B. Coldwell, and F. R. Ewart. The managers were Messrs. A. G. Pierce, R. B. Williamson, and H. A. Pratt.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Stockton-on-Tees Town Council has appointed Mr. S. G. MARSTON, of Sunderland, as general works manager at the Electricity Works at a salary of £650 per annum.

Upon resigning his position with the Ascot and District Gas and Electricity Co., Mr. E. J. H. BLUETT, electrical engineer to the company, has been presented with a silver tea set and tray by the directors, and a malacca horn walking stick, suitably engraved, by the staff. Mr. Bluett resigned his position at the end of May in order to enter into partnership with Mr. A. T. Archer in the purchase of the Sunningdale business of Messrs. John Drake & Co., electrical engineers and ironmongers.

Mr. F. H. HOWELL has been appointed London representative of the electrical cooking and heating department of the Falkirk Iron Co., Ltd., at Craven House, Kingsway, W.C.1. For over 15 years Mr. Howell has been on the staff as district and showroom manager for the County of London Electric Supply Co., Ltd., but this included a period of nearly five years in the R.F.A. He has specialised in electric cooking apparatus from a practical as well as selling point of view, and has recently spent several weeks at the Falkirk Iron Works, where "Falco" appliances are designed and manufactured.

Mr. CHARLES H. GASSON, late of the Electrical Engineering & Equipment Co., Ltd., has now taken up the position of sales manager to Messrs. Hamilton & Liddaman, 12, Charing Cross Road, London, W.C.2.

Mr. HAROLD E. WEBB, A.M.I.E.E., who has a long connection with Messrs. Bruce Peebles & Co., Ltd., has been appointed their London manager.

Mr. JAS. BASTIAN has been appointed London representative to the Cantie Switch Co., Ltd., of Nottingham.

It is announced that Mr. WINSTON CHURCHILL has accepted the chairmanship of the Imperial Communications Committee.

Will.—The late Dr. W. J. I. BRUCE, who died a victim to X-ray injuries, left £6,936.

NEW COMPANIES REGISTERED.

Minirisk Co., Ltd. (175,135).—Private company. Registered June 9th. Capital, £1,500 in £1 shares. To carry on the business of lock makers, manufacturers of electrical and other fittings, constructional and electrical engineers, &c., and to adopt an agreement with J. B. Boland and H. V. Barlow. The permanent directors are: J. B. Boland, 33, Sandileigh Avenue, Withington, Manchester; W. S. Mockett, The Orchard, St. Peters, Broadstairs, Kent. Qualification of permanent directors, 200 ordinary shares; of ordinary directors, 100 shares. Remuneration (except managing director, if any) as fixed by the company. Secretary: W. S. Mockett. Registered office: 47, Victoria Street, S.W.

H. G. Osborn, Ltd. (175,127).—Private company. Registered June 9th. Capital, £1,000 in £1 shares. To carry on the business of electrical and mechanical engineers, manufacturers of and dealers in electrical accessories and mechanical novelties, electrical, magnetic, telegraphic, telephonic, and other appliances, &c., and to adopt an agreement with H. G. M. Osborn. The first directors are: H. G. M. Osborn (managing director), "Westfa," Princes Park Avenue, Golder's Green, N.W.11; Mrs. Amy Osborn, "Westfa," Princes Park Avenue, Golder's Green, N.W.11. Registered office: 9, Rathbone Place, Oxford Street, W.1.

Waverley Glass Works, Ltd. (11,748).—Private company. Registered in Edinburgh June 3rd. Capital, £5,000 in £1 shares. To carry on the business of glass manufacturers, blowers, workers, and pressers, decorators, cutters, engravers, and etchers, electricians, &c. The subscribers (each with one share) are: R. Dalzeil, 2, Dalzeil Place, Edinburgh, glass manufacturer; G. F. Walker, 10, Lochside Street, Crosmyloof, Glasgow. The first directors are not named. Solicitors: Mackay & McIntosh, 124, St. Vincent Street, Glasgow.

Victoria Electrical (Manchester), Ltd. (175,145).—Private company. Registered June 9th. Capital, £6,000 in £1 shares. To take over the business of an electrical engineer and contractor, &c., carried on by J. R. Reef as the "Victoria Electrical Co.," in London, Manchester, and elsewhere. The permanent directors are: R. Hodgkinson (managing director), 43, Welbeck Road, Heaton, Bolton; J. R. Marsh, St. Kilda, 1, Lathom Road, Southport; J. R. Reef (managing director), 59, Camp Street, Broughton, Manchester. Qualification, £50. Secretary: J. R. Marsh. Registered office: 27, Berry Street, Buxton Street, London Road, Manchester.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Tees Power Station Co., Ltd.—Satisfaction to the extent of £21,200 on various dates from February 3rd to March 7th, 1921, of trust deed dated May 7th, 1918, securing £600,000.

Hill Bros. (Magnetos), Ltd.—Particulars of £15,000 debentures authorised June 1st, 1921; whole amount issued; charged on the company's undertaking and property, present and future, including uncalled capital (if any).

Webb's Crystal Glass Co., Ltd.—Mortgage on Dennis Park Glass Works, Stourbridge; Medway Glass Works, Queenborough, Kent; and Royal Castle Glass Works, Hatton, Tutbury, Derbyshire, dated June 1st, 1921, to secure all moneys due or to become due from company to Lloyds Bank not exceeding £25,000.

W. J. Furse & Co., Ltd. (121,420).—Return dated May 13th, 1921. Capital, £35,000 in £1 shares (9,000 cumulative preference and 26,000 ordinary), 9,000 cumulative preference and 21,039 ordinary shares taken up, £10,735 paid, £19,294 considered as paid. Mortgages and charges: £3,000.

Northallerton Electric Light & Power Co., Ltd. (59,301).—Return dated March 9th, 1921. Capital, £6,500 in 2,000 preference shares of £1 each and 12,000 ordinary shares of 6s. each, 1,151 preference and 4,921 ordinary shares taken up, £3,627 6s. paid. Mortgages and charges: £3,900.

Foster Construction Co., Ltd.—Satisfaction in full on May 6th, 1921, of mortgages dated May 10th and August 9th, 1918, securing all moneys then due or to become due from company to bankers. Mortgage on certain properties at High Street, Plaistow, dated May 7th, 1921, to secure all moneys due or to become due from company to London Joint City and Midland Bank, Ltd., also registered.

Northampton Electric Light & Power Co., Ltd.—Issues on May 10th of £440, on May 23rd of £1,400, and on May 25th, 1921, of £100 second debenture stock, parts of a series already registered.

Aladdin Renew Electric Lamp Corporation, Ltd.—Issues on May 12th and 20th, 1921, of £2,000 debentures, part of a series already registered.

Woods-Gilbert Rail Remodelling Co., Ltd.—Debenture, charged on the company's undertaking and property, present and future, including uncalled capital, dated May 18th, 1921, to secure all moneys due or to become due from company to Barclays Bank, Ltd.

CITY NOTES.

Electric Construction Co., Ltd.

The annual general meeting was held on June 9th at Winchester House, E.C., Mr. Philip E. Beachcroft presiding. The chairman expressed the directors' pleasure that they were able to submit accounts which surpassed those of any previous period. The gross profit on manufacturing and contracting for the year under review showed an increase of £44,502. The credit side of the profit and loss account amounted to £169,977, being £41,118 greater than last year. The expenditure aggregated £86,867, being an increase of £24,177. The net profit for 1920-21 was £83,110, an increase of £16,941. It might seem that they had been ultra cautious in not distributing a greater bonus than 2½ per cent. The question, however, had had their most careful consideration, and if times had been normal they would not have hesitated to increase the bonus, but having regard to the prevailing financial and industrial conditions they came to the conclusion that the best interests of the shareholders would be served by making no increase in the distribution. With regard to the balance sheet, stock in trade and work in progress showed an increase of £77,673. It was intended by the Finance Bill, 1921, to grant relief in respect of loss on trading stocks, and although their liability for E.P.D. terminated on March 31st last, they would be entitled to reclaim within certain time limits any loss which might be incurred on stock in hand on that date. Investments showed a reduction of £36,749. This was caused by realisations necessary to finance the larger volume of stock at higher prices, and to complete the important works extensions described last year. On the other hand, cash at bankers was £23,387 greater. On the other side of the account creditors and credit balances were £21,919 greater, but that was accounted for by taxation, their actual trade liabilities being less than a year ago. When they considered the financial stringency which had prevailed necessitating issues of capital by many concerns on very onerous terms, they had every reason to congratulate themselves on the strength of their financial position. If their recommendation was adopted, the general reserve fund would stand at £120,000, and he need not point out that the liberal contributions to that fund in the past had largely contributed to the comparative ease with which they had encountered the trying conditions of the past two years. Regarding the outlook for the new financial year, the statement in the report that recently orders had been difficult to obtain would not have caused surprise, as the industrial conditions throughout the country, in consequence of the coal dispute, were deplorable. He did not consider that this dispute was altogether to be laid at the door of the miners, and he thought that had the coalowners and miners been left to themselves to settle their own differences without the intervention of the Government, the matter would have been settled sooner. As it was, about 3,000,000 (of whom over 1,000,000 were miners) were now unemployed, and their ranks were being increased daily, and unless a speedy peace was attained there was grave risk that many industries in the country, as well as the mines themselves, would to a great extent be irremediably destroyed. Coal had been regarded as the life blood of industry, but the present stoppage of supply had to some extent found its remedy in the use of alternative heating agents. The mine leaders should take cognisance of that fact, and the miners themselves realise that it was more than possible that their source of employment was endangered by the use of oil gases for many, if not all, industrial purposes. Even if the coal dispute were settled there could be no immediate recovery because manufacturers of pig iron, steel, and other staple articles of consumption would be reluctant to resume operations until they were satisfied that they could produce at prices which would compete with foreign manufacturers. Before the country could recapture its export business or meet foreign competition in the home markets lower costs of production were essential, and those could only be brought about by a lower standard of wages and salaries and a lower margin of profit, and by increased output. British taxes, compared with those of other competing countries, were absolutely crushing. They were three times heavier than French ones, and six or seven times those of Germany, and about four times heavier than those of the United States. In the electrical industry the number of inquiries for plant and apparatus indicated that there was a large amount of work waitng to be done, but buyers would not place their orders in the expectation that prices would fall. The result was that new business for the moment was very unsatisfactory, but many factories were employed on orders which were placed several months ago. The chairman finally referred to the death of Sir James Pender.

United Electric Tramways of Montevideo, Ltd.

The directors' report for the year ended March, 1921, states that the gross receipts of the tramway system for the year ended October, 1920, were at an exchange of $4.7 to the £, £516,130, an increase of £72,436. Unfortunately operating expenses also showed a continuing increase, mainly due to higher wages and taxation, and were larger during the year by £52,483, leaving a net increase of £19,953, but remittances had been affected by the fall in exchange. The passengers carried numbered 63,220,875, an increase of 8,336,956. The car miles run were 8,830,112, an increase of 1,073,478. Fifteen motor cars and 14 trailer cars have been ordered, and four new cars are being constructed in the company's workshops in Montevideo. This rolling stock should be ready before the end of the year. After providing for administrative expenses and charging £46,539 for debenture interest, the credit balance is £74,907, plus £7,032 brought forward. £5,961 has been put to debenture stock redemption, £2,500 redemption of preference and ordinary capital, £30,000 to renewals and contingencies. An interim dividend at the rate of 6 per cent. per annum, less tax, has been declared on the cumulative preference shares, and a final dividend of like amount has been recommended. It is proposed to pay 4 per cent., less tax, on the ordinary shares for the year, and to carry forward £8,477.

Callender's Cable and Construction Co., Ltd.

The report for 1920 shows a balance to the credit of profit and loss account of £182,920. Debenture interest absorbs £13,500, preference dividend £41,000, depreciation of buildings, plant, and machinery £30,000, depreciation of office furniture £500. The balance brought forward was £105,803, and the available balance is £203,723; 15 per cent. (less tax) on the ordinary shares requires £75,000, there is put to reserve for corporation profits tax £7,500, the balance of the new issue expenses £13,122 is written off, and £108,101 is carried forward. During the year covered by the accounts the volume of business increased considerably, and, in spite of enhanced costs of materials and labour and many difficulties in manufacturing, the sum available as profit on the 12 months' operations is in excess of that of any previous year. In June last, new capital was raised to meet the expansion of the company's business and also the outlay on the new buildings and plant at Erith. This new capital was available only in the latter part of the year, and, consequently, the full benefit therefrom was not experienced during the period now under review. So as to bring the capital of the company more into line with other industrial undertakings, the £5 shares, both preference and ordinary, were, in May, 1920, subdivided into five shares of £1 each, and it is believed that this will be of advantage to the shareholders. The relations between the company and its employés have been excellent. A satisfactory arrangement has recently been completed on a sliding scale basis with the workpeople at Erith and Leigh, and it is confidently anticipated that this will prevent labour disputes in the future. It is to be regretted that considerable difficulty has lately been experienced owing to the miners' strike, which rendered it impossible to obtain fresh supplies of fuel. The cost of production, owing to higher wages and shorter working hours, and heavier costs generally, has rendered it difficult

to compete in several foreign and overseas markets. It is hoped, however, that the lessened prices of raw materials now current and the recent arrangement with regard to labour will enable the company to restore its foreign trade connections to their former importance. The new workshops referred to in last year's report have now been completed, and the manufacture of e.h.t. cables for 30,000 volts and upwards is proceeding satisfactorily. Important orders have already been received for such cables. The reorganisation of the Picardy works for the manufacture of telephone cables has also been completed, and large contracts have been secured. The Anchor Cable Co., Ltd., has had a busy year, and has secured satisfactory profits.

The French Electrical Industry.

Information concerning the electrical industry in France is contained in the annual report of the Compagnie Francaise pour l'Exploitation des Procédés Thomson-Houston for the past year. The report mentions in the first place that the electrical industry is one of those which have suffered the least from the economic crisis following the war. On the whole the production of plant of small capacity has considerably diminished for the time being, but on the other hand, the manufacture of equipment of large size has not slackened. The equipment of waterfalls and the construction of large generating stations are being continued, and the railway companies are now proceeding with the electrification of an important part of their networks. The company has so largely profited from this privileged situation that the total value of its orders in 1920 exceeded by 80 per cent. that of the orders for the preceding year. Coming to consider the company's own manufacturing works, the report states that these have been specialised as follows: Jarville for small alternating current motors, Neuilly for small continuous current motors, Vaugirard and Lecourbe for heavy plant, Suresnes for large apparatus, and Colombes for insulating materials. To these has now to be added the great new works at Saint-Ouen, where a year ago the land resembled a vast racecourse, but is at present occupied by extensive buildings. Operations at this works are already proceeding, the production comprising machines of very large sizes and very high voltage. The Lesquin works, which was destroyed during the war, is being actively reconstructed, and will be provided with a foundry for cast iron, a steel foundry, and a large shop for small electrical apparatus.

The report proceeds to refer to telephony, and mentions in this connection that the company has entered into close relations with the Western Electric Co. of New York, whose importance in telephony is equal to that of the General Electric Co. in the general domain of electricity. The initial agreements which have been reached are so essential that the French company expects to find in this new association a reinforcement of the important facilities at its disposal to ensure the development of telephony in France. On the other hand, the relations of the company with the General Electric Co. are constantly developing and becoming more intimate. As to the question of railway conversion in detail, the report states that the discussions with the Orleans Railway Co. aiming at the electrification of the line from Paris to Orleans have resulted in the beginning of operations. Other negotiations have been made with various firms, and the company has formed, with the co-operation of Schneider & Co. and the Ateliers de Constructions Electriques du Nord et de l'Est, the Société d'Etudes pour l'Electrification des Chemins de Fer in order to prepare for the three participants the submission of schemes to the railway companies and ensure the joint use of their powers in carrying out the work. As was mentioned in a previous issue, the dividend for 1920 is at the rate of 40.70 fr. net for registered shares and 37.80 fr. for bearer shares.

General Electric Co. (U.S.A.).

The report of the company for 1920 shows that the value of the orders received was $318,470,438, as compared with $237,623,932 for 1919. At the close of the year the amount of orders unfilled was $111,778,000, as compared with $98,880,000 at the end of 1919. The unprecedented amount of orders received by the company during the first seven months of 1920, plus the unfilled orders at the beginning of the year, resulted in most urgent efforts in a difficult situation to add to the manufacturing facilities. The expenditure for additional land, buildings, machinery, and equipment during 1920 was $31,300,496; as a further addition to the manufacturing capacity of the plants, certain factories with a floor space of 1,768,000 sq. ft. have been leased, with options to purchase. The total factory floor space has been increased from 20,681,000 sq. ft. in 1919 to 24,501,000 sq. ft. in 1920. The amount of sales billed was $275,758,487, an increase of $45,778,504 over 1919. The net result was a profit of $26,460,057, plus income from other sources $8,960,558, less interest and discount on debentures $1,969,111 and interest on notes payable $2,319,216, leaving available for excess profits tax and dividend $31,132,287. Excess profits tax estimated at $9,000,000, dividends $10,656,222, leaving a surplus for the year of $11,476,065. At a special meeting of the stockholders held in March, 1920, authority was given to increase the capital stock of the company from $125,000,000 to $175,000,000. During the year the directors authorised the issue of two special series of 1919 and 1920 debentures known as employés' investment bonds to be sold to employés on the instalment plan by deductions from wages. To these two issues subscriptions have been received from about 12,000 employés totalling $4,031,800. These debentures bear interest at the rate of 7 per cent. per annum. In November, 1920, the directors offered to the employés the privilege of subscribing for from one to ten shares of the company's capital stock, payments to be made on the instalment plan by deductions from wages. The subscription price was $136 per share, and as stated in the circular offering the stock, there will be a credit amounting to $20 per share against the subscription price which will represent a net return substantially the same as that which would be enjoyed by anyone purchasing stock on an instalment plan, paying interest on deferred instalments and receiving cash and stock dividends. The result of this offering was that 30,747, or 36 per cent. of all the employés on the pay roll subscribed for an amount considerably larger than the 50,000 shares offered. In the year 1920 the dividends declared were as follows: Cash dividends 8 per cent., $10,651,306. Stock dividends 4 per cent., $5,437,700. Cash dividends on International Co. preferred stock held by employés $4,916. Total, $16,093,922. It is proposed commencing January 1st, 1921, to separate the balance sheets and financial statements of the General Electric Co. (U.S.A.) and the International General Electric Co. in order more satisfactorily to show the assets, liabilities, and operations of each company.

Richardsons, Westgarth and Co., Ltd.

The accounts for 1920 show a profit after providing for estimated liabilities to the Government of £155,635, plus £48,842 brought forward, less two years' preference dividend paid in June, 1920, £42,000; total £162,477. Interest on the 4½ per cent. debenture stock absorbs £15,750, one year's preference dividend £21,000, and the directors propose making the following allocations: Directors' fees £1,700, depreciation for 1920, £45,000; portion of capital expenditure in 1920 written off £25,000, leaving £54,027. The directors propose to pay out of balance two years' dividends on preference shares in addition to one year's dividend paid in December last as above. Preference dividend will then have been paid up to April 30th, 1919. In consequence of inability to obtain coal, the works are practically closed down. Many contracts remain to be completed, but it will be difficult to get further orders until the cost of production has been considerably reduced in regard to both materials and wages.

French Companies.

The Société d'Electro-Chimie de Bozel intends to pay a dividend at the rate of 22 fr. per share for 1920, as in the preceding year, the net profits having been 1,036,000 fr. and 762,000 fr. in the two years respectively.

The Compagnie d'Electro-chimie et d'Electro-Metallurgie proposes to pay out of net profits of 3,700,000 fr. a dividend at the rate of 40.50 fr. net per share, being the same rate as in 1919, when the net profits were 3,591,000 fr.

The Compagnie d'Electro-Mecanique, after writing off 3,576,000 fr. for depreciation, reports net profits of 3,528,000 fr. for 1920, as against 2,318,000 fr. in 1919. The dividend is to be at the rate of 40 fr. per share, as in the previous year.

The Société L'Appareillage Electrique Industriel Petrier, Tissot & Raybaud, of Lyons, makers of low and high-pressure apparatus, report net profits of 533,000 fr. for 1920, and a dividend of 86 fr. gross per ordinary share. The company expects to be able to remove to its new works in the course of the present year.

Alldays & Onions, Ltd.—Profit on the year's working £7,111, which has been allocated together with the reserves appearing in the last balance sheet to the purposes of meeting depreciation and writing off. It has been found during the past year that the financial condition of the country rendered it advisable to postpone the raising of additional capital until a more favourable opportunity presents itself.

Rees Roturbo Manufacturing Co., Ltd.—Dividend of 8½ per cent., less tax, on preference for the year 1915, and for nine months ended September 30th, 1916, £5,000 to depreciation reserve, £4,600 to general reserve, £5,000 to a taxation reserve, £4,523 for maintenance of buildings, plant, &c., carrying forward £6,727.

Howard & Bullough, Ltd.—Final dividend on the ordinary shares, making 10 per cent. for the year, transferring to dividend reserve £40,000, carrying forward £50,956.

Manila Electric Railroad & Lighting Corporation.—Dividend of 1½ per cent. for the quarter ending June 30th on the common capital stock.

American Telephone & Telegraph Co.—Dividend of 2½ per cent., less tax, for the quarter.

Canary Islands.—The report of the Société de l'Electricité de Las Palmas for the last financial year shows a loss of 1,139,259 fr.

Belgium.—The report of the Société d'Electricité et de Mecanique (Procédés Thomson-Houston et Carels), of Ghent, for the last financial year shows a profit of 2,722,551 fr.

Waygood-Otis, Ltd.—Dividend of 9 per cent. on the ordinary shares, carrying forward £27,929.

Stock Exchange Notices.—Application has been made to the Committee to allow the following to be officially quoted :—

Metropolitan Electric Supply Co.—£500,000 7½ per cent. extension debenture stock.

Dealings in the following have been specially allowed by the Committee under Temporary Regulation 4 (3) :—

General Electric Co.—£3,500,000 7 per cent. mortgage debenture stock, issued at 92½ per cent., £15 paid and fully paid (varying interest payments), after issue of allotment letters.

Eastern Extension Australasia and China Telegraph Co.—92,794 shares of £10 each, fully paid, Nos. 300,001 to 390,629 and 397,836 to 400,000.

Kaministiquia Power Co.—2,000 shares of $100 each, fully paid, of capital stock; $372,000 thirty-year five per cent. gold bonds, Nos. 876 to 1,000 of $1,000 each; Nos. 1,304 to 1,433, 1,534 to 1,564, 1,569 to 1,584, 1,586 to 1,720, 1,791 to 1,818, and 1,847 to 2,000, of $500 each.

Siemens Bros. & Co.—300,000 10 per cent. cumulative preference shares of £1 each, fully paid, Nos. 1 to 300,000.

The undermentioned have been ordered to be officially quoted :—

Eastern Extension, Australasia & China Telegraph Co.—92,794 shares of £10 each, fully paid, Nos. 300,001 to 390,629 and 397,836 to 400,000.

Kaministiquia Power Co.—2,000 shares of $100 each, fully paid, of capital stock; $372,000 30-year 5 per cent. gold bonds, Nos. 876 to 1,000, of $1,000 each; Nos. 1,304 to 1,433, 1,534 to 1,564, 1,569 to 1,584, 1,586 to 1,720, 1,791 to 1,818, and 1,847 to 2,000, of $500 each.

British Electric Traction Co., Ltd.—Dividend of 4 per cent. on the ordinary stock for the year, carrying forward £177,318.

Electric & General Investment Co., Ltd.—Dividend at the rate of 6 per cent. per annum (3s. per share), less tax, on preference shares for the six months ending June 30th.

New Issues.—*Johnson & Phillips, Ltd.*—The British, Foreign & Colonial Corporation, Ltd., is inviting applications for £350,000 8 per cent. first mortgage debenture stock at 96 per cent., repayable at par by means of a cumulative sinking fund commencing in 1922 by twenty-three equal annual drawings, the first of which is to be made in 1923 and the last in 1945. The list closes to-morrow, the 18th.

Ruston & Hornsby, Ltd.—Profit for the year ended March 31st, 1921, £108,682, less depreciation £53,002, interest on debentures £25,500, leaving £30,180, plus £37,240 brought forward, making £67,420. Dividends on preference shares absorb £23,500, leaving £43,920. The directors have decided, owing to the stagnation of trade, that it is desirable to conserve the resources of the company and regret they do not recommend the payment of a dividend on the ordinary shares for the past year. The balance £43,920 is carried forward.

Kidderminster & District Electric Lighting & Traction Co., Ltd.—Net receipts for 1920 of lighting undertaking, including payments under guarantee by Shropshire, Worcestershire and Staffordshire Electric Power Co., were £5,304, plus £46 brought forward. After deducting administration and general expenses, and interest on temporary loans, the balance is £2,710. Dividend on cumulative preference shares absorbs £1,500. Dividend of 2½ per cent. on the ordinary for 1920, carrying forward £35.

Penarth Electric Lighting Co., Ltd.—The report for the year ended December 31st last shows total revenue £14,990, working expenses £8,549, balance £6,440. To renewals £2,450. 7½ per cent. dividend on the ordinary shares, carrying forward £2,331.

Hungary.—The report of the Ganz Electrical Co., Budapest, for the last financial year shows a profit of no less than 5,522,262 crowns, as compared with only 1,553,182 crowns in 1919. The dividend is being increased from 5 per cent. to 12 per cent.

Eastern Telegraph Co., Ltd.—Dividend at the rate of 3½ per cent. per annum, less tax, on the preference stock for the June quarter, and an interim dividend of 2½ per cent. on the ordinary stock, free of tax.

Madras Electric Supply Corporation, Ltd.—Dividend of 8 per cent., less tax, on ordinary shares for the year. £15,000 to general reserve, £1,000 to employés' gratuity fund, carrying forward £9,620, subject to excess profits duty (if any).

Merthyr Electric Traction & Lighting Co., Ltd.—Dividend at the rate of 6 per cent. per annum on the ordinary shares, to reserve £1,200, to renewals £5,000; carried forward £1,429.

Globe Telegraph & Trust Co., Ltd.—Further dividend of 3s. per share, less tax, on the preference shares, and 5s. per share net on the ordinary shares.

James Keith & Blackman Co., Ltd.—Dividend on ordinary shares for year ended March, 1921, at the rate of 15 per cent. per annum, free of tax. To reserve £13,000, forward £18,272.

Mackay Companies.—Quarterly dividend of 1½ per cent., less tax, on common stock.

STOCKS AND SHARES.

TUESDAY EVENING.

More interest is taken, in the Stock Exchange markets this week, in cricket than in stocks and shares. Business in the latter is exceedingly quiet. In spite of the reluctance shown by the public to take a hand in the markets, there is still a brisk demand for underwriting of any good issue which comes along. The underwriters of the General Electric Company's 3½ million pounds' 7 per cent. debenture stock were left with 43 per cent. of their obligations. In a couple of days it was assumed that many of the weaker underwriters had cleared out of their holdings, at prices ranging from 4½ discount to about a point more. As soon as the air cleared of the underwriting stags, the price promptly improved to 3 discount, and, with the prospect of money becoming cheaper, this stock will probably advance to its issue price of 93. At 90 it may be deemed a cheap investment.

Another newcomer to the markets this week is the 10 per cent. preference share of the Siemens Company. The shares were given away to the holders of the ordinary in the proportion of one preference for five ordinary held. The new preference shares began at 20s. 6d.-21s. 6d. Considering that the company is paying 10 per cent. free of tax on its ordinary shares, these 10 per cent. preference shares at anything like 21s. 6d. certainly look cheap, offering a return of 9½ per cent. on the money. As soon as the Siemens' holders who wish to take their profit have divested themselves of their preferences, the quotation will stand a good chance of improvement. As already mentioned, the North Metropolitan Electric and the Pernambuco Tramways both have new issues in immediate contemplation.

Activity in Underground Electric Railways stocks and shares has somewhat subsided as compared with that which ruled a week ago. Nevertheless, prices continue firm, and London Electric Railways shares have come into some little favour on the basis of 55s. The bulk of the shares are owned by the Underground Electric Railways of London, and there is not much floating supply in the Stock Exchange market. Last year's dividend was 1½ per cent., *i.e.*, 2s. 3d. per share on the £10 fully-paid share. Thus they offer a small return on money invested, which is more than the Underground Electric £10 shares themselves do, although the two stand at nearly the same prices. There is, however, more market in the latter than in the former, and this, of course, accounts for something in the matter of market quotation. The interest in the various traction issues has quieted down again, and there is not much change in London & Suburban Traction at 7s. 6d., nor in the ordinary at 2s. 6d. The company's 4½ per cent. first mortgage debenture stock changed hands last week at 44½, but the 5 per cent. "A" debenture stock, which is now quoted 68, has not been negotiated in the Stock Exchange since last August, when a buyer paid 61.

British Electric Traction ordinary is a little better at 35¼. The 6 per cent. participating preference is quoted at 59, the 5 per cent. debenture at 68, and the 4½ per cent. second debenture stock at 51. The company's report, out this week, shows that the net profit has risen £12,000 to £135,000. The usual dividend of 4 per cent. is paid, and the carry-forward is increased by £20,000 to £177,000. The B.E.T. has sold its £190,000 War Loan, substituting shares, *inter alia*, in Brush Electrical, Electric & General Investment, and Transport Power & Finance. Besides these, the list of investments receives an addition in the shape of about £71,000 in Stoll Picture Productions. It would be useful, as well as interesting, if the chairman at the forthcoming meeting were to say what the company's investments are worth at the current quotations, the report itself affording no information on this head.

Marconi shares have developed weakness, owing to a fair number of shares having been sold by people who had bought them earlier in the year, and who are disappointed at the delay in the settlement between the Government and the company. The price has dropped to 2¼, and the preference are down to the same level. Marconi Marines have fallen to 25s. As we pointed out recently, there is very little doing in the Marconi market nowadays, and, with speculation all but dead, prices yield easily to a little selling pressure.

The only change in the list of home electricity companies is a rise to 5¼ in Westminsters. The manufacturing group is almost equally quiet. General Electric preference drooped to 17s., the 6½ per cents. and the 7½ per cents. both standing at the same level. Henley's is 1/16 down at 1¼. Edison-Swan first preference gave way to 17s. A sensational fall—in price at all events—in City Services shares lowered the quotation 80 points to 200, the preferred at 57½ being about 10 points down. This slump came about on the notification that the company would in future pay its Common share dividends in stock instead of cash. Newcastle-on-Tyne 7 per cent. preference shares are better at 19s. 6d.

Anglo-American Telegraph deferred has risen 2 points to 83¼. Great Northerns are lower at 25¼. United River Plate Telephones eased off to 6, and West India & Panama are lower at 10s.

The Government of Mexico has noted that it intends to resume payment of interest on its foreign debt on July 1st. This brought about a rise in Mexican Government bonds, but

did not affect prices in the Utility market. Mexico Tramways firsts are better at 52¼, but Mexican Light firsts at 74½ show a dollar fall. Brazil Tractions are 1½ down at 34½. Anglo-Argentine Tramways continue to improve. British Columbia stocks are steady. There has been some demand for the 4½ per cent. Vancouver debenture, without, however, finding any response, sellers refusing to part with their holdings.

Although rubber is still about 8½d. per lb., the market in the Stock Exchange is slightly better, owing to the fact of the deliveries of the produce once more being in excess of the landings. Engineering shares are quietly firm, with Babcock & Wilcox 1/16 up at 2⅞. It is taken for granted that there will be a resumption of work in the coal trade next week. With business as quiet in the Stock Exchange as it is at the present time, men are inclined to ask whether this eagerly-anticipated resumption will have any noticeable effect after all in strengthening prices throughout the markets.

In our lists of quotations we have brought the dividend-payments up to date, as far as possible. The varying times at which different companies close their books render it impossible to adopt a strictly uniform plan. The Edison-Swan Company, to take one example, paid its last dividend in November, 1919, when the distribution for that year was 10 per cent. The India Rubber Company paid 6d. a year ago, and nothing since. The Anglo-Argentine Tramways is clearing off on its second preference shares. Marconi shareholders received 1s. last December, and 8s. in the previous half year, when the capital was much less. The instances are quoted to give an idea of the difficulty which confronts the effort to do the work accurately. They may serve to recall the entreaty, "Don't shoot the man at the piano, because he's doing his best."

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1919.	Dividend 1920.	Price June 14, 1921.	Rise or fall.	Yield. £ s. d. p.c.
Home Electricity Companies.					
Brompton Ordinary	12	12	6	—	£10 0 0
Charing Cross Ordinary	7	8	8½	—	10 6 6
do. do. do. 4½ Pref.	4½	4½	8	—	7 10 6
Chelsea	4	6	8½	—	9 4 8
City of London	13	14	14½	—	11 16 0
do. do. 6 per cent. Pref.	6	6	17/-	—	7 1 2
County of London	8	8	8½	—	9 17 0
do. do. 6 per cent. Pref.	6	6	6½	—	7 7 8
Kensington Ordinary	7	9	4½	—	10 18 2
London Electric	3½	3½	1	—	7 10 0
do. do. 6 per cent. Pref.	6	6	22	—	10 18 2
Metropolitan	6	7	8½	—	10 0 0
do. 4½ per cent. Pref.	4½	4½	24½	—	7 18 2
St. James' and Pall Mall	12	12	6	—	10 0 0
South London	6	7	9½	—	9 2 10
South Metropolitan Pref.	7	7	15/9	—	8 17 10
Westminster Ordinary	10	10	6½	—	9 10 6
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	83½	+2	7 3 9
do. Def.	1½	1½	17½	—	8 11 6
Chile Telephone	6	6	5½	—	5 6 8
Cuba Sub. Ord.	7	7	7½	—	9 6 8
Eastern Extension	10	10	16½	—	6 3 2
Eastern Tel. Ord.	10	10	187½	—	5 19 5
Globe Tel. and T. Ord.	10	10	168	—	6 0 4
do. do. Pref.	6	6	9½	—	6 9 9
Great Northern Tel.	23	24	25½	— ⅛	8 11 6
Indo-European	10	10	35	—	7 2 10
Marconi	25	25	2½	— 1/16	—
Oriental Telephone Ord.	12	12	2⅛	—	*5 13 0
United R. Plate Tel.	8	8	6	— ⅛	6 13 4
West India and Panama	Nil	Nil	½	— 1/16	Nil.
Western Telegraph	10	10	16½	—	*5 18 5
Home Rails.					
Central London Ord. Assented	4	4	48½	—	8 15 10
Metropolitan	1½	1½	26½	—	5 17 8
do. District	Nil	Nil	20	+1	Nil
Underground Electric Ordinary	Nil	Nil	9⅛	—	Nil
do. do. "A"	Nil	Nil	7/6	—	Nil
do. do. Income	4	2	80½	+1	2 9 4
Foreign Trams, &c.					
Anglo-Arg. Trams, First Pref.	5½	12½	2⅛	+ 1/16	9 15 6
do. do. 2nd Pref.	Nil	5½	2⅜	—	8 16 0
do. do. 5 % Deb.	5	5	86½	+2	7 15 0
Brazil Tractions	Nil	Nil	34½	—1½	Nil
British Columbia Elec. Ry. Pfce.	5	5	56	—	8 18 6
do. do. Preferred	5	5	65½	—	*8 15 0
do. do. Deferred	3	3	61½	—	*11 17 6
do. do. Deb.	4½	4½	80½	—	7 2 10
Mexico Trams 5 per cent. Bonds	Nil	Nil	69½	+1	Nil
do. 6 per cent. Bonds	Nil	Nil	29½	—	Nil
Mexican Light Common	Nil	Nil	11⅝	—	Nil
do. Pref.	Nil	Nil	16⅝	—	Nil
do. 1st Bonds	Nil	Nil	74½	—1	Nil
Manufacturing Companies.					
Babcock & Wilcox	15	16	2⅞	+ 1/16	6 14 6
British Aluminium Ord.	10	10	16/3	—	12 6 2
British Insulated Ord.	15	10	1⅝	—	9 12 0
Callenders	15	15	1½	—	10 0 0
" 6½ Pref.	6½	6½	17/6	—	7 8 7
Crompton Ord.	10	10	16/3	—	12 6
Edison-Swan	10	10	11/3	—	—
do. do. 5 per cent. Deb.	5	5	70	—	7 2 10
Electric Construction	10	10	17/6	—	11 8 6
English Electric	8	8	12/-	—	13 6 8
Do. Pref.	6	6	14/6	—	8 5 6
Gen. Elec. Prof.	6½	6½	17/-	—6d.	7 13 0
do. Ord.	10	10	1⅛	—	*9 8 2
Henley	15	15	1⅜	— 1/16	16 18 2
do. 4½ Pref.	4½	4½	8½	—	6 18 6
India-Rubber	10	10	⅛	—	—
Met.-Vickers Pref.	8	8	1⅜	—	8 16 10
Siemens Ord.	10	10	23/3	—	*8 12 0
Telegraph Con.	20	20	80½	—	*5 17 0

*Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, June 14th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	10d.	..
a Ammoniac Sal	per ton	£75	..
a Ammonia, Muriate (large crystal)	"	£65	..
a Bisulphide of Carbon	"	..	..
a Borax	"	£34	..
a Copper Sulphate	"	£38	..
a Potash, Chlorate	per lb.	7d.	..
a " Perchlorate	"	8d.	..
a Shellac	per cwt.	£90 10s.	..
a Sulphur, Sublimed Flowers	"	£18	..
a " Lump	"	£16	..
a Soda, Chlorate	per lb.	5d.	..
a " Crystals	per ton	£7	..
a Sodium Bichromate, casks	per lb.	9½d.	..
METALS, &c.			
p Babbitt's Metal Ingots	per ton	£95 to £300	..
c Brass (rolled metal 2' to 12' basis)	per lb.	11¼d.	..
c " Tubes (solid drawn)	"	1/1½ to 1/2	..
c " Wire, basis	"	11½d.	..
c Copper Tubes (solid drawn)	"	1/8½	..
c " Bars (best selected)	per ton	£116	..
c " Sheet	"	£116	..
c " Rod	"	£116	..
d " (Electrolytic) Bars	"	£79	£3 inc.
d " Sheets	"	£145	..
d " " Wire Rods	"	£95	£2 inc.
d " " H.C. Wire	per lb.	11¼d.	¼d. inc.
f Ebonite Rod	"	8/6	..
f " Sheet	"	8/-	..
g German Silver Wire	"	2/9	..
h Gutta-percha, fine	"	14/- to 16/-	..
h India-rubber, Para fine	"	11d.	¼d. inc.
i Iron Pig (Cleveland Warrants)	per ton	Nom.	..
i " Wire, galv. No. 8, P.O. qual.	"	£40	..
g Lead, English Pig	"	£28 5s.	10s. dec.
g Mercury	per bot.	£10 15 to £11	10s. dec.
e Mica (in original cases) small	per lb.	4d. to 4/-	..
e " " " medium	"	5/- to 10/-	..
e " " " large	"	12/6 to 25/- & up	..
p Phosphor Bronze, plain castings	"	1/4 to 1/9	..
p " " rolled bars and rods	"	2/1 to 2/6	..
p " " rolled strip & sheet	"	2/3 to 2/7	..
d Silicium Bronze Wire	per lb.	1/4	..
r Steel, Magnet, in bars	"	1/8	..
n Tin, Block (English)	per ton	£167 to £168	£26 to £7 dec.
n " Wire, Nos. 1 to 16	per lb.	4/-	..
p White Anti-friction Metals	per ton	£78 to £300	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
p ———
r W. F. Dennis & Co.

How to Use Oil Fuel.—In a letter to the *Manchester Guardian*, "Practical" gives some hints to those who have changed, or who contemplate changing, over from coal to oil burning. With regard to burners, the best is the cheapest; if a cheap burner has already been obtained, do not waste time trying to improve it; cut your losses, and buy a good burner—if possible, one with a spraying effect, to obtain the better flame, and not a miniature hosepipe. It is most essential that the apparatus should be provided with proper means for controlling the air, in order to ensure a proper mixture. If the burners have been fixed to a battery of boilers, it would be a paying proposition to install a small compressed-air plant, and thus save a large quantity of the steam which is being used as the oil driver.

The oil after passing through a filter into the gravitation tank should be heated to about 160° F.; a ½-in. pipe provided with a controlling valve will be found efficient for heating it. The oil should pass into the tank in a steady flow (not emptied direct out of the barrels), and so maintain an even temperature to ensure a proper atomisation of the oil when leaving the burner.

After an employer has attended to the above, it is the duty of the engineer and fireman to display the necessary intelligence and attention to the plant to obtain the best results. Oil fuel, no doubt, has come to stay if the oil syndicates will deliver at £3 10s. per ton and guarantee constant supplies, if an efficient burner at a reasonable price is used, and, lastly, if proper attention is given by the engineer.

The Metric System Adopted in Japan.—The new Weight and Measure Law, as passed by the Diet, was formally promulgated recently by the Japanese Government, thus rendering Japan one of the metric countries. Simultaneously with the promulgation of the new Law, Director Kitsukawa, of the Weight and Measure Office, gave out a statement, saying that even when the first weight and measure law was framed in 1893, Japan was desirous of adopting the metric system, but the nation was not ready to accept it. When the world war started, however, the necessity of adopting the metric system was keenly felt, and the Government Bill was readily accepted by the Diet.—*Board of Trade Journal*.

THE FAILURE OF METALS UNDER INTERNAL AND PROLONGED STRAIN.

The symposium and general discussion held on the above subject on April 6th at the Institution of Mechanical Engineers must have been unique in the interests represented thereat. It is understood to have been promoted by the Faraday Society, but no less than five of the big engineering societies participated; namely, the Institution of Mechanical Engineers, the Iron and Steel Institute, the Institute of Metals, the North-East Coast Institution of Engineers and Shipbuilders, and the Institution of Engineers and Shipbuilders in Scotland. The result of this co-operation was that data were brought forward and light thrown upon the subject by engineers, metallurgists, physicists, and chemists, although it must be confessed that the contributions of the first of these classes, whose interest in the subject ought to be the keenest of all, were decidedly disappointing. Perhaps the reason for that was the one implied in the speech of Mr. L. Pendred—as a matter of fact, our bridges and other structures do actually stand, and don't spontaneously fall to pieces like some of the specimens described or shown. The engineers should be told that this durability may be more a matter of good fortune than of skill or knowledge—as a matter of fact, it isn't even quite true, as contributions to the discussion bore witness—and seeing that engineers usually employ some five times as much material as they should (disguised by that euphemistic phrase " factor of safety ") physicists may reasonably retort that the engineer has still much to learn from molecular physics. The little note alone presented by Mr. John Arnott (of Messrs. J. & G. Weir, Ltd.) was enough to make the most complacent of users wonder what material really *can* be trusted! Here is a standard phosphor bronze bar on the market supposed to be as immaculate as Cæsar's wife, and yet which has had so much cold work put into it for it to attain a high yield point and tensile strength that it is full of incipient yet invisible transverse and longitudinal cracks, which tell their tale to the one who is acute enough to have his suspicions after three minutes' immersion in a mercurous nitrate solution.

One may profitably consider again the examples quoted in two excellent contributions to the discussion coming from America, from Mr. James E. Howard and Mr. Henry S. Rawdon. Thus the former stated that recent examinations of structural shapes have shown the presence of internal strains of compression equivalent to 12,000 lb. per sq. in., which is three-fourths of the usual allowable stress for a compression member in current engineering practice. Seeing that no account is taken of internal strains in structural members exposed to compressive stresses, the fact is noteworthy. Mr. Howard also instanced the transverse fissures that occur in rails as a result of the augmentation in service of original cooling strains, and Mr. Rawdon supported this view by describing actual examples.

Of special interest to electrical engineers were the cases of spontaneous failure of the lead sheathing of telegraph cables brought forward by Mr. L. Archbutt. These were examples of almost pure lead-covered cables which had been laid for periods varying from 9 to 13 years and which had not corroded, but had developed fine cracks that opened out on bending the cable. In other cases the sheathing of cables laid for some 40 years was as good as when first laid. In one instance of failure the cracking had actually led to a breakdown of the insulation. In every case it was found that the cracks were intercrystalline, and that there was a striking difference between the shape and size of the crystals in the defective parts and the sound portion of the sheath. Experiments were made on lengths of sheathing subjected to tensile strain and to vibration, and it was found that such cable was particularly prone to failure. Mr. Archbutt's conclusion was that the long-continued action of a stress in lead, much less than that necessary to cause immediate elongation, will cause the crystals gradually to lose their cohesion and come apart, and the failure is connected with a weak type of crystalline structure.

It will be convenient at this stage to consider the subject in its general aspects, and what follows will be based upon the very lucid introductory review with which the discussion was opened by Dr. W. Rosenhain.

The essential differences between ordinary external and internal stresses are that with the former, generally speaking, the element of time enters only very slightly into the result, and when in a strained metal rupture occurs it takes place across the crystals. In the internal stresses which produce the so-called " season-cracking," the fracture takes place *along the crystal boundaries*, and in these cases the apparent strength depends very largely upon the time during which the stress acts. The action was first observed in brass tubes or cups in which circumferential stresses had been set up in the process of manufacture, but externally-applied stresses may also cause season-cracking, and since 1919 effects have been observed in metals other than brass, such as lead, steel, and aluminium alloys. The mode of origin of internal stresses is tolerably certain: they are the result of unequal changes of dimension in different parts of the same piece of metal, due to either mechanical or thermal causes. The nature of their operation is more obscure. The strains or fractures resulting from these stresses must be of quite a different character from a simple ultimate stress, for fracture can occur far below the ultimate strength of the material. The explanation urged by Dr. Rosenhain is founded on the well-known theory of the existence of an amorphous film between the crystal grains of metals. It is supposed that under the action of long-continued stress this amorphous material will flow like an under-cooled viscous liquid, and this movement may eventually lead to intercrystalline rupture. Motion will, however, only occur if the boundaries of the crystals are smooth and regular; if jagged or irregular, the intercrystalline flow will not take place. Thus the facility with which season-cracking or similar failures take place will depend on the micro-structure of the metal. Strong support was given to this view by the striking photomicrographs shown by Dr. Rosenhain and others, but its acceptability, of course, depends on the evidence for the existence of the hypothetical amorphous film. As to this, Sir James Ewing put forward a very clear and convincing argument on general grounds for the irregular orientation of the molecules at the boundary where one crystal merges into its neighbour. Such irregularity is nothing more than the supposed amorphous layer.

The amorphous boundary explanation was strongly criticised by Dr. W. H. Hatfield, who brought forward evidence that increasing the time of application of stresses does not result in a lower breaking load, which should be the case if viscous flow was the cause of fracture. This evidence was hardly conclusive, and it was supported by the fact that many metals are stressed at high values for indefinite periods without rupture occurring. Here again, however, a determining feature would be the microstructure.

Another explanation of season-cracking ascribes it to corrosion or other forms of chemical action. In Dr. Hatfield's view, such action induces weaknesses in metals already stressed, and thus facilitates rupture. Mr. Harold Moore thought that corrosion would take place in the amorphous film itself, and thus be a prime cause of failure by causing a breakdown at the crystal functions. He brought forward evidence based on the action of ammonia on stressed brass, although in the case of steel the corrosive action would be that induced in the ordinary way by moist air. Dr. Rosenhain, with much force, showed that chemical action although it might sometimes be an important factor or might have an accelerating effect, was not essential to the failure of metals under internal stress.

A contribution by Prof. C. H. Desch established the fact that where metals are subject to chemical or corrosive action, whether of liquids or gases, although it is not true of all reagents, such action frequently advances along the intercrystalline boundaries, and this course is most likely to occur when the metal is in a state of tension. The action of mercury and its salts on strained metals is specially noteworthy, and it may be utilised to demonstrate the existence of strains on incipient fracture otherwise invisible.

We may suitably conclude this very general description of the course of the discussion with a brief reference to one or two of the more striking examples of failure brought forward and not already alluded to. Messrs. Vaudrey and Ballard described the failures—either fire-cracking or season-cracking—which sometimes occur in certain sizes of drawn brass tubes arising from an apparent stratification of the wall of the tubes. This condition arises when a tube is subjected to too large a " sink " in drawing (" sink " is the reduction of internal diameter), without sufficient reduction in thickness, and stratification of the tube may occur on a too-sudden application of heat on annealing. The minute flaws are rendered visible by immersion in an acid solution of mercurous nitrate.

Mr. W. C. Hothersall described the spontaneous cracking on storage which sometimes occurs in the necks of small arm cartridge cases. These cracks were shown to arise as a result of stresses set up in the necks subsequent to semi-annealing, and it was thought that they were mainly set up during the " necking " and " bulleting " operations. The example is the more interesting because mercury is present in the cap composition, and it may have a determining effect in bringing about rupture.

A paper by Mr. O. W. Ellis described some experiences of season-cracking in brass rods obtained during the war. Mr. Ellis's figures are based on the tests made at Woolwich on samples taken from 2,500,000 rods of varying shapes and sizes. It is difficult to generalise from the results, but it may be said that certain consignments of rods of some grades gave quite a high percentage of failures. Rods of square section of certain sizes seemed particularly prone to season-cracking. It was eventually found that low-temperature annealing removed the internal stresses, and enabled rods to be passed as sound which otherwise would have ruptured under the tests. The general question of preventing season-cracking in brass was dealt with in an exhaustive paper read by Mr. Harold Moore and Mr. S. Beckinsale, of the Research Department, Woolwich. These authors have made a systematic study on the reduction of stress by low-temperature annealing in 70/30 brass cold-rolled to 120, 160, and 200 Brinell hardness, in elastically-bent test strips of each hardness initially stressed to 11, 17, and 22 tons per sq. in. maximum tension. Temperatures from 200 deg. to 325 deg. C. were employed. It was

found that at the lower temperatures while the rate of reduction of stress is fairly rapid at first it becomes very slow when the stress has been reduced to about one-half, and the higher the initial stress, the longer the time required to reduce it to a given fraction. The harder the brass the more rapidly is a given initial stress reduced at a particular temperature. The experiments left no doubt but that by suitable low-temperature annealing not only can the liability to season-cracking be eliminated, but it can be done without harmful effect to the quality of the brass.

Failure in steel parts or articles is probably less frequent than in brass, and less study has been given to this metal in this regard. Nevertheless, some interesting and striking cases of failure were brought forward. Thus Sir Henry Fowler instanced the deterioration of certain locomotive boiler tubes, the ends of which were found to have become quite brittle. The tubes, owing to war conditions, had been made of inferior steel, and failure appears to have been caused by the concentration in the crystal boundaries of the impurities, notably phosphorus, but why this should have happened is unknown, unless it was the repeated stresses set up during the work of the locomotive. Of the 6,000 tubes in service on the Midland Railway only eight appear to have developed this curious brittleness. Mr. D. Hanson, however, described other types of intercrystalline failure in steel as a result of prolonged stresses which are more common. Thus, several cases have been observed in mild steel boiler plates that have failed in service. In one instance severe cracks developed in a wrapper plate from the combustion chamber of a marine boiler around the edges between the rivet holes. It was found that in the portions which failed the cementite mainly occurred in the form of intercrystalline films. Another similar case quoted was the drum of a water-tube boiler, and a third case a number of plates from a high-pressure marine boiler. Such failures had also been observed in cold drawn steel tubing after use in a nitre bath at 300 deg. C. There were no working stresses in the tube, which evidently had become subject to serious internal stresses as a result of the cold drawing.

Several speakers referred to the failures which sometimes occur in tools and tool steel, and a paper on this aspect of the subject was presented by Mr. J. Neill Greenwood. Hardened steel is in a condition of considerable stress, due primarily to the suppression of allotropic and phase changes causing the metal to occupy a smaller volume than it normally would. Consequently even at ordinary temperatures long-period changes take place involving evolution of heat, change of volume, and so forth, and sometimes the stresses are greater than the normal cohesive forces keeping the steel together—and it flies to pieces. Mr. Greenwood analysed these internal changes very closely, and he showed how proper tempering may relieve them. He also showed the influence of free carbide and non-metallic inclusions in weakening the steel, and the beneficial influence of manganese and chromium, which reduce internal stress irregularities by making the quenching effect more uniform.

We have not attempted to do anything like justice to the great amount of data and number of opinions brought together in the course of the discussion. It has only been possible to draw attention to some of its outstanding features, and those who desire to give the subject serious study must go to the full report of the discussion, which we understand will be published in due course by the societies which co-operated to organise it.

It remains to say that the meeting which began at 2.30 did not terminate until 10.30, although there were merciful intervals for rest and refreshment, and the successive sessions were presided over by Prof. Alfred W. Porter, Capt. H. Riall Sankey, and Admiral Sir George Goodwin, presidents, respectively of the Faraday Society, Institution of Mechanical Engineers, and Institute of Metals. Illness kept away Dr. J. E. Stead, president of the Iron and Steel Institute, and a telegram was sent to him from the meeting.

RECENT DEVELOPMENTS IN TURBINE PRACTICE.

Discussion at Manchester.

Mr. K. Baumann's paper on the above subject, which was abstracted in our issues of April 15th and 22nd, was discussed by members of the North-Western Centre of the Institution of Electrical Engineers on April 12th.

Prof. G. Stoney described the paper as an epoch-making one, and hoped the author would, after a term of years, or sooner, give them another paper which would continue the good work he was doing. He practically agreed with every point in it, and thought Mr. Baumann was quite right in saying that the critical speed of the turbine should be near the running speed. The increase in steam pressure, temperature, and vacuum, as well as in size of turbine, was growing steadily with no sign of saturation. Apparently it might go on for ever, but he was afraid they would soon come up against the properties of material in the superheater. The vacuum had steadily improved, and they were now reaching the point where they were coming up against the temperature of cooling water, and until somebody invented some way of getting over the second problem of thermo-dynamics, he did not think they would get a much better vacuum than they had now, which meant that the factor Parsons called κ and Mr. Baumann called Sigma, had to be increased and that, of course, had a direct bearing upon the velocity ratio and the B.th.u.'s available. The speaker especially liked Mr. Baumann's rule for the factor of safety—an exceedingly good rule and a safe one—very much better than basing it on the ultimate strength only. The beautiful optical methods, and so forth, of measuring elastic limit were not really commercial. He agreed with Mr. Baumann that four-bearing designs were very much more satisfactory than three-bearing designs as regarded vibration, but confessed that he had a liking for flexible couplings between the turbine and the alternator, although so many were now making long and rigid couplings which were running quite satisfactorily. That was more especially the case with more than two shafts running in line as with tandem alternators or steam turbines. Regarding the vibration of turbine disks, the mathematical solution of the problem was exceedingly difficult and not very satisfactory. Of course, experiments would be expensive to carry out, but he had experimented with rubber disks 7½ in. in diameter, and he had always found that they vibrated on two nodal diameters. He exhibited a model in lead of the shape the disk assumed, and explained that it had a nodal diameter one way and another nodal diameter at right angles. He never succeeded in making his rubber disks vibrate with four nodal diameters, and was considerably surprised to hear that the author said they did so. Mr. Baumann was quite right in thinking that there was a great future for the 3,000 r.p.m. turbine in big power schemes. With an output now of something like 15,000 kW, which they could get at 3,000 r.p.m., the advantage of running at the lower speed of 1,500 r.p.m. was in fact negligible. On the other hand, they had the immense advantage of smaller forgings and costs, and it was quite impossible to get really reliable large forgings. High-grade material such as chrome-nickel steel was all right for small articles such as aeroplane and motor car engines, but its use for very large forgings was very doubtful indeed. The difficulty of forging high-grade steels was very great indeed. An impulse turbine would be very much improved if the shrouding was not only riveted, but also brazed on; riveting was always flexible for small movements, and the amount of damage to the shape of the blading was infinitesimal. The author's analysis of the variation of the economical rating under various conditions was most valuable. It was a great pity that turbine makers had not been more candid about breakdowns that had occurred and their causes. It would have greatly increased the rate at which progress had been made if such candour had been more widely prevalent. The ratio of blade height to mean diameter was most important, because it was comparatively easy to make a blade which would stand up against a centrifugal force, but it was much more difficult to make a disk do so. Many troubles might be avoided if two-cylinder designs were more largely adopted for very large sizes, apart entirely from the question of leaving losses. Leaving losses, for the most ordinary sizes, could be quite well dealt with in a single cylinder design by Mr. Baumann's multi-exhaust, which was one of the most radical and greatest improvements in turbine design that had been made of late years.

Mr. H. L. Guy, while applauding the motive which caused the author to pass lightly over the merits of the multi-exhaust, feared that it might result in the principles and properties of that construction being as little understood as his motive. It was not clear from the very brief description of the very novel construction what happened in the inner tiers of blades at the low-pressure end of the machine, and the effect was certainly not appreciated by some of those who took part in the discussion in London. The great advantage of the multi-exhaust construction was that it enabled one to employ a smaller mean diameter for the stages than could be employed for any alternative construction. From that fact a very large number of advantages flowed which not only improved the efficiency of the machine, but very materially affected its speed and reliability. Before Mr. Baumann arrived at the solution of the problem, the machines which the speaker's firm was building for speeds of 3,000 r.p.m. and outputs up to about 6,000 kW were typical of the machines being produced by other makers in this country and other parts of the world. The immediate result of remodelling that line of machine (the principal change consisting of a reduction in the mean diameter of the wheel to about three-quarters of that which they had been using up to that date, in spite of the fact that the output with which the new machine would deal, was increased to three times the output of the old machine), with the consequent changes which had been outlined in the paper, was that the blade stresses were reduced by over 20 per cent., as compared with the blade stresses which had been employed by them for many years. The stresses in the disks were reduced to three-quarters of their old values; the stresses in the diaphragm blade were reduced to two-thirds of the old ones, and the deflections of

the diaphragms (because of their very much smaller diameter) were easily reduced to one half of what had been commonly allowed before, and it was possible at small cost to increase appreciably the margin between the running and critical speeds of the turbine. A small vibration occurred at some distance from synchronism between the running and critical speeds, and a smooth-running turbine was obtained. It was also possible, because of the much smaller dimensions, to make of cast steel at a reasonable cost many of the parts which had previously been made of cast iron, and that would result in such machines being able to stand higher temperatures than had commonly been the case. The disks also, because of their much smaller diameter, could be made so stiff that their first critical speed was appreciably above the running speed. There were additional advantages; there were nine counts at least upon which the reliability of the machine could be materially improved; the efficiency was immediately improved and the percentage of loss was materially reduced.

Mr. S. L. Pearce explained that a good deal of the paper was based upon American experience, and as he had had the opportunity last autumn of visiting the States and seeing almost all the large turbine plant that the author had referred to, he could very readily associate himself with the latter's remarks with regard to the frankness with which American engineers had disclosed all their troubles. In connection with very large turbine plant, it was to the United States that they must look, and from the States they could learn a great deal of what to avoid and, possibly, what to adopt. He had met the author in the States and discussed much of the plant they had seen. Generally speaking, one could fairly say that the record of single-shaft machines in the States had not been altogether satisfactory; there had been far too many wheel failures. The first two tables in the paper would well repay ample consideration. Referring to item 20 in Table I. the machine built for the Manchester Corporation by Messrs. Richardsons, Westgarth in conjunction with the Metropolitan-Vickers Co. had an economical rating of 20,000 kW, but the maximum continuous rating of the machine should be 25,000 kW. Item No. 26 in that table was very interesting, especially as it was styled "Proposed practice for 1921." So far as the steam end was concerned, at any rate, that machine would never be built. As regarded the possible size to which single-shaft machines could be carried, namely, 30,000 kW at 1,800 r.p.m., and 35,000 kW at 1,500 r.p.m., personally he thought those sizes were safe—with the particular type of exhaust for which the author was responsible. Dealing with turbine troubles, it seemed that practically in every case the fundamental cause was vibration. It was very important that users and designers should come together, and that there should be a frank exchange of opinion on both sides. One rather radical departure in the modern G.E. designs was in connection with the shaft packing. He formed a very definite opinion that there was a reaction setting in in the States in favour of the reaction type against the single-shaft impulse turbine for very large sets on account of the troubles which had been experienced. At any rate, one of the principal designers in the States, when discussing the Barton machines, said that he would not care to design or manufacture the Barton machines having such a large heat drop as they would have in a single cylinder; further, he thought the economical temperature of the steam should never exceed 700 deg. Mr. Pearce said he saw the 30,000-kW Brush Ljungstrom machine delivered by the General Electric Co. in course of construction, and it was interesting to know that the G.E. engineers did not believe that the thermal economies which were expected to be obtained from that machine would counterbalance the excessively heavy cost of construction. One was surprised to note the small average size of turbines, resulting partly from the fact that all turbines had been included whether for power stations or industrial work. Probably if power stations alone had been taken they would have shown a higher average, though the percentage in favour of the impulse, as against reaction type, might possibly not be quite so high if some of the smaller impulse machines were ruled out. The American Westinghouse Co.'s machines, chiefly of the reaction type, had been freer from trouble than the G.E. machines. The company had built turbines up to 30,000 kW rating in a single cylinder with a sort of semi-double end. It had an impulse wheel and reaction, and those operated from a l.p. double end. But the tendency seemed to be to go in for the purely reaction two-cylinder machine with a double l.p. end. For outputs bigger than 35,000 kW the company had adopted the triple-cylinder cross-compound type, which was really a very interesting machine. The Duquesne Electric Lighting Co.'s station had been built for five 50,000-kW sets of the triple-cylinder cross-compound type, which would show a slightly superior thermal economy to anything else the speaker came across in the States. Their steam pressure was 300 lb. and vacuum 29 in.; with 1 h.p. and 2 l.p. cylinders the steam consumption was 10¼ lb.; 1 h.p. and 1 l.p. 11.2 lb., and 2 l.p. 14 lb. The points in favour of the triple-compound type were that the separate cylinders enabled the high and the l.p. elements to be designed quite independently and, therefore, to the best advantage as regarded speed and mechanical strength. Secondly, a slightly higher thermal efficiency could be got for the combination in comparison with single sets of the same aggregate capacity. Thirdly, the l.p. turbine could be run even if the h.p. cylinder was out of commission. Against the arrangement was the extra capital outlay per kW installed, the extra floor space, and last, but not least, the extreme complication of working. It was a question of balancing the points for and against, but he did not think the requirements of this country were likely to call for 60,000-kW sets, so probably the point would not arise. The Interborough Rapid Transit Co., which was responsible for the introduction of that machine, in its latest extension had reverted to the single-shaft single-cylinder turbine. On the question of the feed water, the author was an optimist, and so far as the total elimination of erosion was concerned he had gone a little too far. It could not be done completely by arranging the feed water in a closed cycle. They must go further than that, and certain arrangements were receiving attention at headquarters. The use of kerosene was first made in this country at Stuart Street; the idea was originally extracted from some German technical production. The Glasgow results given by the author were extremely valuable. If they could get those results in Glasgow the speaker was perfectly certain they would beat them at Barton. The broad conclusion he had come to on British and American practice was that American manufacturers were not so advanced in the development of turbine engineering on sound lines as British manufacturers. He had compared the best plant in each case, and they showed less high percentage efficiencies. He reported on those lines to his committee when he came back from the States, and he sent a copy of that report to a very eminent consulting engineer on the other side of the water, who said: "I agree with you entirely. I regret that I have to do so."

Mr. Newton was in general agreement with Mr. Baumann's opinions. There was still a certain reluctance amongst engineers to accept high-speed turbines; he expressed a very strong preference for the high-speed turbine as being the more reliable. Chrome nickel steel disks showed a very slight percentage of trouble up to about 30 or 36 in. diameter. Larger forgings of the same kind of steel had shown a very great percentage of scrapping in the shops. In one case, out of ten disks eight were scrapped, a most heartbreaking experience. Except for the largest stations, he would choose turbines of from 12,000 to 15,000 kW at 3,000 r.p.m.

Mr. G. A. Juhlin thought that the author's opening remark that there was no advantage to be obtained on the electrical side from high speed was perfectly correct, but development had nevertheless taken place in order to take advantage of the increased economy on the turbine side. British practice headed the list, and the actual development of large sizes started with the 10,000-kW set which was already begun in 1916, but it could not be proceeded with on account of the war. They were in a position to ask the turbine builder to follow the alternator, as they had no difficulty in producing the electrical end so as to absorb the power of any of the turbines that a designer might put forward. He associated himself very strongly with the author's recommendation with regard to factors of safety. That point was of particular interest on the electrical side where they dealt with a high-tensile material such as nickel-chrome-vanadium steel.

Mr. K. Baumann, in reply, pointed out that if a disk vibrated on a four-nodal diameter it meant that the deflection of the disk itself was very small. They had attempted to measure that deflection, but had not been successful. The only conclusion that it was vibrating on a four-nodal diameter was based on work which had been done for them by the greatest authority on the subject, who said there was a possibility of the disk vibrating on a four-nodal diameter. In the States in the Curtis turbine made by the Westinghouse Co. the shrouds of the various blades were brazed together so as to prevent vibration, but he was not sure whether it would pay in their type of turbine; he preferred to get something more substantial. For very large sets the use of two-cylinder designs might be desirable, but in this country they had not arrived at that size under ordinary steam conditions, and with sets such as they were making or modern power stations they were on the right lines as far as single-cylinder construction was concerned. The speaker did not think the power station of the future would contain the 35,000 and 30,000-kW sets of which they had heard a great deal. He had become a little more conservative than he was before he went to the States, and did not think the 50,000-kW turbine was necessary. He would not recommend the development of 50,000-kW machines if that involved a speed of more than 2,000 r.p.m.; future turbine development must be on the lines of increasing the output of the 1,500-r.p.m. machine, and progress in that direction would depend to a certain extent on the output which could be obtained from the alternator at that speed. A 35,000-kW economical rating could be used, but it would be better to go slow in that connection. A modern single-cylinder machine would be very satisfactory, and single-cylinder turbines could be made which did not involve the use of any large diameters; large diameters were responsible for a deal of the trouble in the States—not only from disk vibration, but also trouble resulting from large deflection.

The Magnetic Declination.—According to the report of the Astronomer-Royal, the mean magnetic declination for the year 1920 was 14° 8·7′ W; it is decreasing by 9·5′ a year.

JOINT ELECTRICITY AUTHORITIES.

The West Riding Inquiry.

(*Concluded from page 767*).

THE POWER COMPANY'S CASE.

Shortly before the adjournment on May 25th, Mr. HUNTER GRAY, K.C., opened the case for the Yorkshire Electric Power Co. He quoted at length from a report of the Conference engineers, and suggested that the facts and figures given there, as a result of close inquiry, relating to the Power Company's undertaking and the existing undertakings of the various local authorities, showed very good reasons why the supply of electrical energy in the area should remain in the hands of the Electric Power Company. He acknowledged the various witnesses' generous references to the work of the company during the course of the inquiry. The attitude of the company was not one of obstruction. It was desirous, within its powers, of helping to better the interests of the community, but it would be absurd for the company to pretend that its first duty was other than to look after the interests of its own shareholders, particularly as certain classes of its investors had been unremunerated for some years. The company believed it was possible to arrive at a much better condition of affairs than existed to-day. The Leeds scheme foreshadowed the demise of the Power Company by slow starvation, and if the company had to choose between such starvation and being brought out at a fair price, he did not think there was much doubt as to its choice. If the Commissioners or the parties came to the conclusion that the Power Company should be bought out under either scheme, the first difficulty would be in arriving at the price. The second, and more serious, difficulty was that of satisfying the company as to the security for the payment of the moneys which might be agreed upon. He had heard nothing in the inquiry which would satisfy the company that a figure approximating the large figure justified could safely be guaranteed to the Power Company. The company was not desirous of parting either with the whole or any part of its undertaking, and he offered three alternative proposals, submitted in order of preference to the company. If none of these was acceptable, the company would consider, under certain circumstances, the transfer of its undertaking.

The three proposals were: (1) That the company was willing and able to undertake the responsibilities of a Joint Electricity Authority in the district; (2) the company was prepared and had formulated its plans to go on under its present powers and also to supply those districts in which there were no authorised distributors; (3) the company was prepared to go on under its present wide, though in some respects not wide enough, powers. He agreed, with regard to the first proposition, that except in name the company could not act in anything but a private capacity, but doing everything which the proposed public Authority would have to do, and it would have to be done under the supervision of the Commissioners. He maintained that this was the most simple and effective solution of the serious difficulty which existed in the district. For twenty years the company had been developing steadily along the lines laid down by the promoters of the schemes as necessary to supply the district with energy.

In answer to a comment by Mr. H. Booth that if the company became the Authority it would have to get Parliamentary powers, Mr. GRAY said that if the Ferrybridge station were built on the scale contemplated in the company's application, it would have the necessary capacity. So far as he knew there was no limitation beyond the fact that under the 1901 Act the company was precluded from supplying in certain districts, including some of the districts represented by Mr. Greene. He imagined the necessary powers could be obtained by special Order of the Commissioners without going to Parliament; but if Parliamentary machinery were necessary, it would be set in motion by the company. He could not recommend the second and third proposals as so desirable as the first. In every respect the Ferrybridge site was suitable. There was ample water supply already, a peculiarly suitable site for the ashes, and a convenient site for the fuel. Some 25,000,000 kWh were at present supplied by the company, and there was every reason to expect a big development of the colliery demand for electricity and a demand for the Port of Goole. Mr. Gray pointed to the engineers' report as having admitted that the desirable alternative to the public Joint Authority suggested was for the Power Company to be appointed the Authority, which, from an engineering point of view, would be a most satisfactory arrangement. For all the practical purposes affecting the interests of the community he contended that it was sound that the Power Company should supply the whole area, and he held that it was only for political reasons—the question of municipal trading as against private trading—that company control was precluded in the view of the Conference.

On May 26th Mr. W. B. WOODHOUSE, engineer and general manager of the company, was in the witness-chair for the greater part of the day, and it was gathered from his evidence that the company's proposal was to extend its own powers and operations and to leave the present authorities in control of their own generating stations. By this means amicable arrangements could be reached which would prove equally effective and would occupy far less time than the establishment of a Joint Electricity Authority. He pointed to the company's past experience in reaching working agreements as proof of his contention.

At the outset Mr. WOODHOUSE stated that the average density of population in the company's area was 0.6 per acre, while in the large boroughs it was 13.7 per acre. The load factor of kWh sent out from the company's system for the year 1920 was 35 per cent. For the year ending March of that year the average cost to the company per kWh sent out of its stations was 0.667d., based on the average price of coal for the period—£1 7s. 4½d. per ton—while the average price charged for energy was 1.452d. per unit.

There were no fewer than fifteen local authorities whose electric lighting orders had been revoked because they did nothing with them, and it was because of that that the Yorkshire Electric Power Company had developed. To overcome the difficulty of distribution, the Electrical Distribution of Yorkshire, Ltd., was formed in 1905, for the purpose of supplying electricity purchased in bulk from the Power Company. Eight local authorities transferred their lighting orders to the company, which also took out additional ones, and it had also power to supply for traction purposes throughout the whole of its area—a power which it considered important. It had working agreements with 40 out of 63 local authorities, as well as with the Bradford Corporation, with which it had co-operated during the war to their mutual satisfaction. There were 31 districts in the company's area.

It proposed to erect a new generating station at Ferrybridge with plant of the capacity of 135,000 kW, and with the assistance of that and the plant of Leeds and Bradford it could supply the whole of the electricity for the area. Mr. Woodhouse enumerated a list of resolutions in support of the scheme from public and private bodies, and added that the company always had been and always would be ready to discuss any scheme with any other interested bodies in the area.

Mr. HUNTER GRAY, K.C. (for the company): Would the company consider parting with the undertaking at a fair price if the Commissioners thought it absolutely necessary?—The company don't wish to sell their undertaking, but they are prepared to continue its development. They have shown by their past work that they are best fitted to deal with this particular area.

Mr. E. WOOLL (for Leeds): The first criticism in your representations is that you don't approve of the area. Have you any objection to it beyond the obvious fact that it involves a certain severance of your undertaking?—No.

You submit that there is no necessity for a Joint Electricity Authority. I should not think you put that forward with very grave conviction?—We do. There is in existence a company which can carry out the duties of a Joint Electricity Authority. The company is in a position to deal with this matter at once, without any delay or any call on the Treasury or on any public service.

Mr. A. T. MILLER, K.C. (for the Conference scheme): Your proposal would leave each large municipality in its present position in control of its own generation?—Yes.

If the Power Company could obtain control of all these generating stations would that be an advantage?—I don't think the present is the time for a change of ownership, and I don't see the necessity for single control of all generating stations. I think all the advantages to be obtained by single control could in practice be obtained by agreement.

You would expect to have no difficulties in the continued existence of generating authorities controlling their own management in Leeds, Bradford, Halifax, Huddersfield, Barnsley, Keighley and these other places?—No. I think our experience shows that these difficulties can be got over.

Mr. A. G. LUPTON, Chairman of the Yorkshire Electric Power Company, gave evidence as to the capital issues of the company and its growth since inception, and was followed by several witnesses, colliery managers, and secretaries, who spoke as consumers for the retention of the Power Company at present. Mr. ARTHUR THOS. THOMPSON, general manager of the Manvers Main Collieries, and also authorised to speak for the South Yorkshire Coal Trade Association, said they thought the municipal schemes altogether too large and not tending either to efficiency or economy, as managed by municipal bodies. They much preferred to get what they wanted from a private firm managed by business people who understood their work.

Mr. J. H. COCKBURN, secretary of the South Yorkshire Coal Trade Association, said it was not practicable and could not reasonably be expected that any electricity authority composed of representatives of local authorities could ever make its scheme pay. It was a gigantic mistake, his association thought, and everyone would be doomed to disappointment.

Mr. H. F. SMITHSON, general manager of the Airedale Collieries, Castleford, was the last witness, and all agreed, in reply to Mr. E. Wooll, for Leeds, that a scheme retaining the company was preferable to one providing for its immediate acquisition.

On Friday—the ninth and last day of the inquiry—Mr. HENRY PICKARD, chief engineer to the trustees for the Aire and Calder Navigation, Ltd., gave evidence in favour of the Power Company's proposed capital station at Ferrybridge. He said that site was in the heart of the coalfield, plentifully furnished with water supply for condensation, and handy for delivery of coal. A station there would help in the development of the coalfield and of the Port of Goole, to which ships up to 2,000 tonnage could be brought 50 miles inland. In answer to Mr. R. A. Shepherd (for the Yorkshire Power Co.) witness said Esholt was not well placed for coal delivery, and there was practically no flow in the river in the dry season, as against a good flow at Ferrybridge.

In reply to Mr. E. Wooll (for the Leeds scheme) the witness agreed that the coal facilities and water flow were rather better at the South Accommodation Road site at Leeds, but the site was so confined in area that he would not think of erecting a capital station there.

Mr. ROSLYN HOLIDAY, J.P., a member of the West Riding County Council, general manager of the Acton Hall Collieries, and chairman (during the war) of the West Yorkshire Coal Supplies Committee, gave evidence on behalf of the West Yorkshire Coal Owners' Association, which had an output of 15,000,000 tons per annum. He pointed out the disadvantages of disturbance of the present electricity supply arrangements, leaving pits under the same control to be in the area of two different district electricity authorities. This would be particularly awkward where pits were electrically connected underground. The coalowners knew there would be extensive mining developments east of Ferrybridge which would require much electrical energy, because as the coal got further east it became non-coking, and therefore the possibility of using gas power from coke-oven waste heat became remote. As business men, the coal owners felt that private enterprise was desirable, because in anything which a business man would not risk his money, obviously it would not be judicious to risk the public rates. Owing to the competition of the South Yorkshire Collieries, the West Yorkshire owners had to look far forward in search of cheap power, and therefore they had put their money into the Electric Power Company, although they knew they might not get a return for a long time. They believed the proposed Ferrybridge station of the Power Company would meet the requirements of industry in the area.

Questioned by the CHAIRMAN (Sir John Snell), the witness thought the whole tendency of developments of power for mines was towards electrical power. Winding at present was largely by steam power, but the deeper the shaft the more valuable did electric power become, because its steady drive avoided the strain on the cable caused by the sudden impulses of steam power.

THE POSITION OF THE COUNTY COUNCIL.

Mr. J. C. MCGRATH (for the West Riding County Council) said his clients represented a large proportion of ratepayers and consumers in the area concerned, and they wished to voice their appreciation of the care and trouble taken by the promoters of the respective schemes before the inquiry. It was with regret that the County Council could not agree with either scheme, because it fully realised the need for the utmost development of electricity in the West Riding. The Council held emphatically that the present economic conditions of the country and the character of existing legislation concerning electricity formed an inseparable barrier to the success of either of the schemes propounded, and this affected the Conference scheme in particular because the Conference proposed to take over existing undertakings immediately. One marvelled at the optimism of their case. The industrial conditions of the country were such as to discourage any venture to which was attached even the slightest possibility of any additional burden on the rate or tax payers. It hardly seemed possible for the Joint Authority to buy out the Power Company in these times at a figure which would enable it to supply electricity at a price comparable with that at which the Power Company, with its equipment secured in better times, could supply it. Mr. Miller had suggested that there were no special circumstances in this area which warranted a departure from the rule, as laid down by an Electric Inquiry Committee, in favour of public control; but he (Mr. McGrath) contended that if ever there were special circumstances they were found in the existence of an efficient supply scheme in this area, by way of the Power Company, which had served and was still serving a valuable purpose in the industrial life of the area. Both the schemes, in their essentials, were *ultra vires*, and based on something which could not be found within the four corners of the Statute.

The CHAIRMAN: The promoters of both have made it clear that they are dependent on the carrying out of the Government's pledge to pass into law the Electricity Supply Bill.

Mr. MCGRATH, concluding, said the suggestion of the County Council was that the Commissioners, rather than set up a Joint Electricity Authority in full control, might establish a representative advisory committee for the area to assist the Commissioners.

Sir JOHN SNELL pointed out that the intention of the Act in providing for advisory committees was not so much to have local area advisory committees, as to have committees to advise the Commissioners in general. Mr. McGrath said he quite recognised the intention of the Act, but he thought it could be applied in the way he suggested.

The CHAIRMAN said the point would be given due consideration by the Commissioners.

GENERAL SUMMING UP.

Mr. ALFRED TYLOR, urging representation for the railway companies on any authority set up, pointed out that neither the Leeds nor the Conference scheme provided for this, though the railway companies in the area had a rateable value of £885,000 per annum and a consumption of electricity for lighting and small power in the district of 2,000,000 units in 1920. Electrification of the railways in the area might not be so far off as might be thought, and for them to carry out their obligations to the public the supply of cheap and abundant energy was important. The railway companies were prepared to co-operate in whatever scheme might be adopted. None of the lines in the area were yet electrified, but the density of traffic was of a nature similar to that of part of the Lancashire and Yorkshire Co.'s line in Lancashire, which was electrified. Electrification of the lines in the area was not an improbability in the future, and the railway load in that case would be an important factor in the amount of plant to be installed in the capital station. At the same time Mr. Tylor did not suggest that electrification was imminent, and the estimates of Mr. Woodhouse on that ground, in his evidence for the Power Company, should be regarded with due reserve. All things being equal, the railway companies had failed to find any fault with private enterprise electricity supply hitherto or with the supply likely to be given by private enterprise in the future. They recognised the advantages of centralisation as a means of reducing capital costs, and recognised also that centralisation would probably entail some sort of public control. The criticisms put forward at the inquiry on the forms of constitution of the Joint Authority could be met by modifications, but in neither scheme, so far, was there provision for proper representation of the railway companies or other large consumers.

In answer to Sir JOHN SNELL, who asked if Mr. Tylor could give a rough indication of the railway traction load for the district, Mr. TYLOR said he was advised that the 75,000-kW ultimate load estimated by Mr. Woodhouse seemed to the railway engineers to be very optimistic, even assuming that all the railways in the area became electrified.

The CHAIRMAN expressed some surprise to hear this, in view of the present actual railway load in Lancashire.

In response to representations by Mr. Woodhouse that the Distribution Company, which was not proposed to be bought out, should have proper representation on whatever authority might be constituted, the chairman said that was covered by Section 6 of the 1919 Act, providing for the representation of all authorised undertakers in the area.

Mr. J. A. GREENE, defining the final attitude of the many smaller local authorities comprising the West Riding District Councils' Association, said his clients did not desire the setting-up of a Joint Electricity Authority at all, but much preferred that the authorities which had generating stations fit to be continued should come to a working agreement with the Electric Power Co., and that, in order to avoid any danger of the company's taking a too purely commercial view of the obligation to the public, there should be an advisory committee comprising elected representatives of all the local authorities in the area, on a proportional basis of population. The most dominant factor to-day in any scheme of electricity supply was the financial factor, and the suggestion he put forward would cost practically nothing. The authorities Mr. Greene represented included in their areas many of the collieries as to which evidence had been given, had a population of some three-quarters of a million, and a rateable value of some 2½ millions sterling, whilst, whatever might be the outcome of the inquiry, the big boroughs had their own electricity supply assured, the smaller authorities were greatly affected by what might happen to the Yorkshire Power Co. The present was not a time at which great expenditure should be incurred, even if it might be said in the future that spending now would have been cheaper in the long run. The establishment of a Joint Electricity Authority under either the Leeds or Conference schemes would mean the setting up of a spending authority, with big public funds behind it, whereas if the matter were largely in the hands of a private company, that body would watch demand closely and develop strictly according to requirements on a really commercial basis.

Sir HARRY HAWARD commented on the fact that Mr. Greene's case seemed to indicate that his smaller authorities admitted themselves to be more vitally interested in the question of supply than any of the bigger authorities, and he had pressed for representation, and yet they were not prepared to bear any share of the financial responsibility.

Mr. GREENE maintained that the opposition to the pledging of rates was a solid one. It was all very well to say that it was going to be a mere paper transaction, and that there was not likely to be any call on the rates; but he submitted that the Conference authorities dared not go to the ratepayers and ask: "Will you pay a rate to obtain a supply of electricity?" He contended that the blunt question: "Will you pledge your rates?" had never been put to any of the constituent authorities of the Conference. With regard to the merging of the areas into the Authority, he held that, despite the denials of the promoters, the scheme actually contemplated compulsion on the undertakings to come into the Joint Authority. If it was intended that those which came in voluntarily should be given energy on preferential

terms, that would be a vicious principle. Such a threat did not seem to be legal or likely to secure the sanction of the Commissioners. The Joint Authority must deal with the area as a whole. The smaller authorities would strongly object to the Yorkshire Power Co. being bought out at a high price for the theory of giving the supply into the hands of local authorities. The consumers in the area were satisfied that the Power Co. was already supplying energy at as cheap a price as was practicable. He submitted that no case had been made out for either of the schemes.

Mr. Hunter Gray, K.C., summing up the case for the Power Co., pointed to the fact that practically without exception all the parties had acknowledged that the company had carried out its obligations properly, and had given a cheap supply of electricity. He had not lost hope that agreement between the parties and the company would be reached, either in the immediate future or subsequently. It appeared to be agreed that both the Leeds and Conference schemes, as they stood, were impracticable—the one because it depended upon the consent of the Power Co., and the other because it depended upon that and also upon obtaining fresh powers. That the prices charged by the company were not fixed merely with a view to making dividends for the shareholders was proved by the absence of any dividend for 12 years and until five years ago. It had to be recognised that the intention of the Act of 1919 was to secure co-ordination, but the formation of Joint Authorities was optional to the Commissioners, and he submitted that the West Riding was one of the most notable exceptions to the general intention of the Act, so far as concerned the setting-up of such authorities. The Power Co. was willing and able to supply the whole district under the supervision of an advisory committee, without any of the expenditure suggested in the two schemes, but the company should be given that security of tenure which would enable it to obtain capital, so long as it carried out its obligations in an efficient manner. He suggested that in the absence of agreement between all the parties, the best way out of the difficulty was to give the Power Co. the right to complete its Ferrybridge station at once and undertake the supply of the whole district, under the advisory committee suggested by Mr. Greene.

Mr. A. T. Miller, K.C., closing the case for the Conference scheme, submitted that the Leeds scheme had proved to have the support of practically nobody, and the Yorkshire Power Co.'s scheme was hardly a scheme at all. He suggested that if the hopes of agreement broke down it would be impossible for the Commissioners to come to a decision which would be in the best interests of the community. The result of the inquiry would be, he held, to demonstrate that the best solution of the problem was one on the broad lines of the Conference scheme. The inquiry itself was based on the acknowledged necessity of co-ordination and avoidance of waste and lack of economy involved in a large number of generating stations being run separately and independently. The objections of the County Council and the District Councils' Association sprang from a fear of charges on the rates.

Mr. Woodl, concluding the Leeds case, said there was little disagreement between the schemes, but he must repel the criticisms which indicated that the schemes were extravagant. To get the full harvest there must be the necessary initial expenditure. There was undoubtedly a certain measure of demand for the public control of electricity generation, mainly by public bodies, to the west and north-west of the district. The largest and most important single public body in the area—Leeds—was unable to adopt the views of the bodies comprising the Conference, and saw the better results in a judicious combination of the enterprise of public bodies and a private company. So far as there had been any evidence before the inquiry on behalf of the commercial views of the area, those views were unanimously in favour of the encouragement of private enterprise. Neither the Leeds nor the Conference scheme had, for the moment, been able to produce any evidence of commercial or industrial support. On the only commercial evidence called it would be difficult for the Commissioners to do anything to determine the existence of the Power Co. The Leeds scheme had been put forward as a statesmanlike compromise, but two vital principles on which there could be no compromise were the facts that Leeds was determined to retain its electrical autonomy—it would not part with control of its own generating station—and Leeds was opposed to the principle of acquisition of the Power Co.

Sir John Snell: Do you mean they would decline to take a supply in bulk from an outside authority if the company, for instance, were allowed to erect the Ferrybridge capital station and Leeds were not permitted to put up any further station?

Mr. Woodl: Oh, certainly not; on proper terms they would buy if required, but they would not have it unloaded on them.

Sir John Snell: You object to the acquisition of the Power Co., and yet your own scheme provides for it in 42 years?

Mr. Woodl: At the end of 42 years it *may* be acquired, but I regard that as a declaration of non-intention rather than of intention. We recognise that this is an efficient and economical company, and that it is to the interests of the community that it should continue without being acquired on political principles.

The counsel thanked the Commissioners for their patient hearing, and the inquiry was closed.

London & Home Counties Area.

The Electricity Commissioners opened their inquiry into the London electricity supply at the Institution of Electrical Engineers on Tuesday. All the Commissioners were present, namely: Sir John Snell (chairman), Sir Harry Haward (vice-chairman), Mr. H. Booth, Mr. A. Page, and Mr. W. W. Lackie. They were accompanied by Mr. E. W. Hudson (legal adviser).

Mr. Ll. B. Atkinson (president of the I.E.E.) offered the Commissioners a welcome to the Institution building, and the chairman tendered the thanks of the Commissioners to the Council of the Institution.

The notice given by the Commissioners with regard to the holding of the inquiry was then read. In this it was stated that the Commissioners would inquire into the area to be included in the proposed district and the objections and representations which had been made on account of the inclusion in, or exclusion from, the said district of certain areas, and to consider schemes submitted by (*a*) the London County Council, (*b*) the Conference of Local Authorities owning electricity undertakings in Greater London, (*c*) the London Electricity Joint Committee, 1920, Ltd., (*d*) the Metropolitan Borough Council of Poplar, (*e*) the Great Eastern Railway Co., and (*f*) the London Brighton & South Coast Railway Co.

The Chairman said that the schemes would be dealt with in the order given. The first three schemes were much in agreement on some points, but differed with regard to the composition of the joint authority, and other matters of principle, and this measure of agreement would obviate the reiteration of evidence. The Commissioners would sit on Tuesday, Wednesday, Thursday and Friday of each week.

Mr. Craig Henderson, K.C., who appeared on behalf of the L.C.C., then briefly introduced the scheme presented by that body. In doing so he said that the position which the L.C.C. wished to take up was that it regarded it as a duty and a pleasure to assist the Commissioners so far as they could in their difficult task, and looked upon others who were presenting other schemes or lodging objections to schemes put forward, not as opponents, but as helpers in arriving at what would be the best scheme for the London area.

Referring to the interest which the L.C.C. had taken in the question of electricity supply, counsel said that when the Electricity Supply Act, 1919, was passed, in fact before it was passed, the Council at once proceeded to form committees to look into the proposals of the Bill, and see what they could do towards drawing up a scheme which might be suitable. They entered into communication with the Conference of Local Authorities, and with some of the electricity companies in London, with the result that a Committee of Engineers was formed, which drew up what was now the technical scheme of the L.C.C. proposals. Dealing with this, counsel, after mentioning the increase of plant installed in the area delimited by the Commissioners, between 1914 and 1920, namely, about 18,000 kW per annum, and the increased works costs per unit sold as between 1914 and 1920, this being .69d. in the former and 1.55d. in the latter year, said that the outstanding difficulty of the problem was to build new stations and install new plant. The financial conditions existing at the present time were such that to shut down certain stations which otherwise might have been advantageously scrapped and replaced would be impossible, so that the L.C.C. scheme was based on the retention and development of certain existing stations, with the gradual replacement of other stations in the area. When the scheme was originally presented it was contemplated that it might be possible to build one or more new capital stations by the year 1925-26, and the second stage was to be completed by 1930-31, but it had been considered that it would not be advisable for a joint electricity authority to burden itself with the cost of a capital station under present conditions. Therefore, in the supplementary particulars lodged at the request of the Commissioners, the first stage of the scheme was deferred, so that the authority could properly organise the existing facilities in the area to-day as a preliminary stage. The scheme proposed that eventually there should be four new capital stations, each with a capacity of 250,000 kW, and that two existing stations should also be reconstructed on a much larger scale than they were at present. All the new stations would be situated on the Thames, one at Chiswick and the remaining three east of the Blackwall Tunnel; the stations to be reconstructed were also in East London. The engineers responsible for drawing up the scheme had satisfied themselves that to supply the proposed area it was impracticable to work from one station, having regard to the physical conditions regarding mains in the London area. The new station at Chiswick would take the greater part of the western load, whilst the remaining three, together with the reconstructed ones, would supply East London, where the load was heavier.

Coming to the administrative provisions of the scheme, the local authorities were, said counsel, in agreement with the L.C.C., that it was necessary from the outset to have a central body charged with the administration of the electricity supply in the area. There was some diversity of view, however, as to the constitution of that body. The Council suggested that the joint authority should be as small as possible, consistent, of course, with the adequate representation of the different authorities. It was proposed that it should consist of 28 members, or 29 if the chairman were elected from without. Of those the County Council were to have

eight representatives, the local authority undertakers six, company undertakers six, purchasing authorities outside the administrative county and other local authorities outside not owning undertakings four, railway companies two, and workers in the industry two. The L.C.C. had in view that they were a very large governing authority in the area, and were the purchasing authority for company undertakings in the area, subject to certain rights. Company undertakings to-day represented a capital expenditure of over 20 millions in the proposed area, and the local authorities 12 millions, making a total of 32 millions. The Council were also trustees for the public in the London area, and as such they should have considerable representation upon this central authority which was to control electricity supply. They proposed to transfer the purchase rights to the joint authority, and to include in the financial provisions a clause that the local authorities should be entitled to give financial assistance to the joint authority, on the lines of a similar clause in the Electricity Supply Bill No. 2. The County Council would be in a position to grant financial assistance also, but this would depend upon the constitution of the authority, and upon the adequate representation of the County Council upon it.

Dealing with the special provisions in the scheme, counsel submitted a number of suggested heads for agreement between companies and the joint authority on the question of purchase. These were not included in the scheme, because the Council could not be a party to any agreement for purchase, since their purchase rights would be handed over to the joint authority. The gist of the suggested agreement was that the authorised company distributors who could be compulsorily acquired by the L.C.C. in 1931 and thereafter at stated periods should agree to transfer their undertakings to the joint authority before 1931. In return for this, the companies would obtain a longer lease of life, because provision was made for leasing the undertakings until such time as the existing plant became obsolete. New plant would meantime be installed and the undertakings worked under the supervision of the joint authority.

With regard to the financial clauses, there was only one which raised a question of principle. This was Clause 58, which provided that the joint authority, for the purpose of meeting administrative expenses which were not properly chargeable to capital, and for the period during which no revenue would be received, should charge them on the supply undertakings existing based on the number of units sold. The question of the levy was the subject of some objection, as the L.C.C. would not pay anything towards these expenses.

Mr. GEORGE H. HUME (chairman of the Electricity Committee of the L.C.C.) confirmed the remarks of Mr. Henderson. As to the representation of the L.C.C. on that body, the Council had for many years been safeguarding the interests of the consumers, and they were the only authority which would directly represent the consumer. It was proposed that only the chairman of the joint authority should be paid for his services.

Mr. HUME was cross-examined by counsel and representatives on behalf of a large number of authorities. The Conference of Local Authorities and other municipal bodies represented separately objected to the proportions of the representation.

Watford Urban District Council and Poplar Borough Council asked to be left out of the scheme, as did the Hertfordshire County Council. On the other hand, Surrey wanted to be in, in whole and not in part. As regarded the nine London companies which are associated with the L.C.C. in the technical report, it was suggested that if a long lease, say 60 years, was granted, the necessary capital required by the Joint Authority could be found, the L.C.C. providing the interest. The railway companies, the North Metropolitan Power Co., and the Port of London Authority were all represented to safeguard their interests, and at the close of the cross-examination, the Commissioners put some questions to Mr. Hume.

Mr. J. H. RIDER followed, but only a few minutes remained of the day's sitting.

(To be continued.)

REVIEWS.

The Dynamical Theory of Gases. By J. H. JEANS. Pp. 442; 44 figs. London: Cambridge University Press. Price 30s. net.

Most of our readers will already be acquainted with Prof. Jeans's important book on the dynamical theory of gases, which first appeared in 1904. A second edition was called for in 1916, which was largely rewritten in order to bring the matter up to date, this subject having received a great deal of attention from mathematicians and physicists during the interval. A third edition has now appeared, in which considerable emendations have been made in order to keep up with the growth of knowledge, and the author has added an entirely new chapter on the vexed subject of Quanta, embracing the recent work of Ehrenfest, Sommerfeld, Epstein, and others in this most interesting field of scientific conjecture. It is this chapter which will chiefly commend the new edition to readers of the original book, and some such brief description of its contents as can be appropriately made here is doubtless what will interest them most.

The lucid style of the author is nowhere more apparent than in his manner of approaching this difficult subject of Quanta, in which the laws of classical mechanics, as enunciated by Newton, are set at naught—or, if not exactly at naught, at considerable discount. The classical mechanics permits of any number of continuous motions for every dynamical system. Quantum mechanics does not. Motions which conform to the classical mechanics, but violate the equations of restrictions imposed by the quantum theory are spoken of as "disallowed" motions. This new principle of quanta has been erected to account for certain anomalies of experience to which the dynamical theory of gases leads up to in a very natural manner. We know that all the molecules of a gas tend to move with the same energy. That is to say that the energy of a gas tends to become equally divided among all its molecules independently of their several weights, so that the heavy ones move slowly and the light ones rapidly. The same is true of vibrations. The tendency is for the short vibrations of a continuous fluid to be performed with the same energy as the long vibrations, and as there are so many more of the former, a vast proportion of the total energy must be accounted for by the smallest vibrations. Thus when the smallest vibrations are infinitesimal, as should occur in a structureless medium such as the æther is supposed to be, all the energy of any material in contact with it should pass from the matter to the æther, and stay there. In the words of our author: "It follows there can be no equilibrium between matter and radiant energy until the matter has lost all its energy by radiation." This, however, is a state of things that does not correspond with fact. It is a fundamental want of correspondence which crops up in a great variety of electrical and optical phenomena, and the difficulty is to discover some theory which will reconcile them all.

One way is to suppose that the æther, though subject to every kind of vibration, does not permit of direct interchange of energy between vibrations of different wave length, and to suppose, further, that such interchange can only be effected by the intermediation of matter in some form, and then only in "quanta," or parcels of a fixed amount; suppositions very difficult to maintain in face of the phenomena of diffraction and interference. On the other hand, photo-electrical phenomena afford powerful evidence in favour of the belief that the idea of a quantum of energy corresponds to something that has actual physical existence.

The theory of quanta is a bud upon the tree of knowledge wherein growth is just now going on at highest intensity. That is what makes the subject so interesting. It may turn out after all that the quantum, like entropy, is merely a mathematical symbol, by help of which correct calculations may be made, one that represents nothing objective in the actual world. That remains to be seen. The molecule is now receiving more attention perhaps than the world itself, if the quality of the minds attending be taken into account, and in the next edition of the book before us it will doubtless be considered necessary to advert to the isotopes present in many of the gases whose atomic weights embrace a fraction. Chlorine, for example, exists in two forms whose chemical properties are the same. One form has an atomic weight of 35 and the other form has an atomic weight of 37. All our chlorine having been derived from the sea contains the two in much the same proportions, so that chemists are agreed that 35.46 is the atomic weight for the mixture. On the subject of the atom one could write on unceasingly, so much is being done to unravel the mystery of its structure. The more that is known of this, the more certain becomes the dynamical theory of gases, and doubtless this book is destined to undergo revision in the light of new facts, at intervals of a few years. Long may the author be spared to make the necessary adjustments. His last sentence in the book: "The field which remains unexplored is incomparably vaster and more important than that which has so far been conquered," shows he has Newton's sense of the endless task ahead.

An Amazing Presumption, or an Outrageous Attack on the Great Panjandrum. By SKEPTICUS. Pp. 164. Manchester: John Heywood, Ltd. Price 5s. net.

This book consists of a report of a series of smoking-room gossips between three individuals having the worthy but commonplace names of Tom, Dick, and Harry. They start a discussion on authority and agree that, in general, authority is intolerant and opposed to progress. In dealing with the special case of educational authorities, they make clear that the professional tribes are for the most part only animated gramophones. This is commonplace to almost every undergraduate who is at all observant. This part of the book seems to be a very feeble reflection of Denis Bradley's famous aspersions on bureaucracy.

Dick then develops his views by confuting to his own great satisfaction, and the expressed admiration of his cronies, the sacred doctrines of "the impossibility of perpetual motion," and "the conservation of energy."

The reviewer tried hard to glean some information or amusement from Dick's discourse, but gave up in despair.

Dick's smoking-room friends finally induce him to allow his notes to be published, with the above book as the result.

In the opinion of the reviewer he was ill-advised.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

14,815. "Thermo-dynamic gas generating systems." V. César and E. Franchimont. May 27th. (Belgium, August 20th, 1920.)

14,816. "Means for receiving alternating current electric signals." F. E. Pernot. May 27th.

14,822. "Terminal connection for electric cable, &c." C. A. W. Drury and S. W. Drury. May 27th.

14,849. "Electric connections or couplings." O. T. Banks. May 28th.

14,872. "Telephone call distribution system." G. Deakin and Western Electric Co., Ltd. May 28th.

14,884. "Remote control systems." W. J. Rickets and E. A. V. Sanftleben. May 28th.

14,895. "Electric horns, &c., for motor vehicles." W. F. M. Rose. May 28th.

14,918. "Electric glow lamps." R. L. Woosnam. May 30th.

14,954. "Synchronised non-synchronous machines." Caimpagnie Générale Electrique. May 30th. (France, October 27th, 1920.)

14,966. "Thermionic valves for reception of wireless signals." C. F. Phillips. May 30th.

14,975. "Disconnecting electrical cable joint-box fittings." W. E. Kidner. May 30th.

14,977. "Synchronised non-synchronous machines." Compagnie Générale Electrique. May 30th. (France, March 23rd.)

14,979. "Wireless signalling systems." British Thomson-Houston Co., Ltd. (General Electric Co.). May 30th.

14,980. "Dynamo-electric machinery." F. Murgatroyd. May 30th.

14,996. "High-frequency electric generators." G. Krawinkel. May 30th.

15,009. "Electrical water-heating attachments." F. H. Austen and E. C. Young. May 30th.

15,028. "Electric induction motors and electrical controlling devices." M. Walker. May 31st.

15,047. "Process for electrolytic refining of tin." W. P. Thompson (W. J. Aitkens). May 31st.

15,062. "Electro-magnetic wave signalling systems." M. Latour. May 31st. (France, December 8th, 1915.)

15,075. "Alternating-current electrical instruments." E. W. Hill and G. F. Shotter. May 31st.

15,090. "Guard devices for conductor-rails of electric railways." D. Robinson. May 31st.

15,115. "Copying-telegraphs." M. H. Petersen. May 31st. (Norway, June 17th, 1920.)

15,117. "Synchronous electric motors." Siemens-Schuckertwerke. May 31st. (Germany, July 26th, 1920.)

15,128. "Electric arc-welding machines." British Thomson-Houston Co., Ltd. (General Electric Co.). May 31st.

15,164. "Electric ignition systems." H. L. Curzons. June 1st.

15,171. "Electric, &c., motors." G. F. D. Campbell, W. Heap and J. Meredith. June 1st.

15,182. "Quick make and break electric switch." J. W. Johnson and R. W. Scott. June 1st.

15,209. "Semi-automatic electric signalling." L. R. Gleason and V. Swettenham. June 1st.

15,223. "Magnetos." J. H. Runbaken. June 1st.

15,232. "Vapour lamps." E. J. Cleburne and W. H. Cleburne. June 1st.

15,245. "Electric commutators for ignition systems of internal-combustion engines." D. A. V. Rist. June 1st.

15,256. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. June 1st. (United States, June 18th, 1920.)

15,261. "Resistance units." Mickelwright, Ltd., and W. R. Mickelwright. June 2nd.

15,265. "Electric burglar alarm." A. Hynes. June 2nd.

15,283. "Dynamometers." Kapella, Ltd., and F. W. Preston. June 2nd.

15,284. "Wind dynamos." F. A. Wilkinson. June 2nd.

15,285. "Gear-cases of tramcars." T. C. Winfield. June 2nd.

15,294. "Electric resistances." G. Pelletier and F. Pellin. June 2nd. (France, June 22nd, 1920.)

15,310. "Electrical means for transmitting and reproducing sound." A. F. Sykes. June 2nd.

15,316. "Valve transmission circuits for wireless telegraphy." H. Morris-Airey and L. G. Preston and G. Shearing. June 2nd.

15,324. "Apparatus for propelling conveyor trucks with electric drive." Siemens-Schuckertwerke. June 2nd. (Germany, June 2nd, 1920.)

15,341. "Electric alarms." A. W. Amos, A. L. Lloyd and W. E. Lloyd. June 2nd.

15,342. "Attachment for sparking-plugs." L. E. Gilbert. June 2nd.

15,355. "Medical battery." T. Draper, G. G. Goodman and C. G. W. Nye. June 2nd.

15,362. "Joining insulated electric conductors." Naamlooze Vennootschap Electriciteit Maatschappij Electrostoom. June 2nd. (Holland, June 5th, 1920.)

15,380. "Electrical relays." N. Robinson. June 3rd.

15,401. "Junction box for electric mains and protecting cover for terminals, cut-outs, &c." G. Tempini. June 3rd. (Italy, June 9th, 1920.)

15,402. "Fuse-box safety plug for low-voltage electric cable installations." G. Tempini. June 3rd. (Italy, March 5th.)

15,430. "Electric switch operating mechanism." British Thomson-Houston Co., Ltd. (General Electric Co.). June 3rd.

15,431. "Electric contact fingers." British Thomson-Houston Co., Ltd. (General Electric Co.). June 3rd.

15,435. "Electrodes, welding rods, and soldering sticks." Alloy Welding Processes, Ltd., and E. H. Jones. June 3rd.

15,440. "Radio-telegraphic transmitting stations." J. Bethenod. June 3rd. (France, September 14th, 1920.)

15,446. "Telegraph systems." F. G. Creed and Creed & Co., Ltd. June 3rd.

15,447. "Electric arc lamps." R. Rigby. June 3rd.

15,459. "Joining insulated electric conductors." Naamlooze Vennootschap Electriciteits Maatschappij Electrostoom. June 3rd. (Holland, December 20th, 1920.)

15,460. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. June 3rd. (United States, June 30th, 1920.)

15,461. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. June 3rd. (United States, June 17th, 1920.)

15,462. "Signalling systems for use with electric staff systems on railways." W. A. R. Richards. June 4th.

15,485. "Spark-plug." O. Troya. June 4th.

15,495. "Electrically indicating combined effect of two independent measuring factors or elements." J. E. Lea. June 4th.

15,503. "Cable clamps." C. W. Kemper and J. T. Kemper. June 4th.

15,520. "Electric measuring-instruments." British Thomson-Houston Co., Ltd. (General Electric Co.). June 4th.

15,521. "Electric switch contact fingers." British Thomson-Houston Co., Ltd. (General Electric Co.). June 4th.

15,532. "Electric heating elements." C. B. Gresham and H. W. Sullivan. June 4th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1919.

1,742. "Couplings for electric heaters." Soc. Anon. Dite "Calor." January 24th, 1918. (122,840.)

23,069. "Electric signalling telegraphs." W. F. Grafton and A. D. Jones. September 19th, 1919. (163,351.)

27,471. "Chassis of trackless tramway cars." G. A. Bishop and R. A. Chadwick. November 7th, 1919. (163,355.)

27,905. "Means for transmitting signals over electric supply circuits." P. Trichard. November 11th, 1919. (Convention date not granted.) (135,194.)

28,649. "Electric baling-presses." J. H. Hindle and T. Hindle. November 19th, 1919. (163,365.)

29,029. "Water-tight electric light fittings." I. Kornfield and P. Etchepare. November 21st, 1919. (163,367.)

31,067. "Socket fittings for pin-and-socket connectors for electric circuits." L. M. Waterhouse, H. S. McLaughlin, and Simplex Conduits, Ltd. December 11th, 1919. (163,371.)

31,202. "Variable resistances, dimmers, or cut-offs for electrical installations." L. A. Gow. December 13th, 1919. (163,373.)

32,022. "Wall-plugs and like electric fittings." G. F. Ostins. October 5th, 1920. (163,382.)

1920.

404. "Spark-plugs." R. R. Hill. January 6th, 1920. (163,387.)

1,610. "Brush-holders for dynamo-electric machines." W. F. Grafton. January 17th, 1920. (163,398.)

2,084. "Electro-magnetic switches." British Thomson-Houston Co., Ltd. (General Electric Co.). January 22nd, 1920. (163,407.)

3,454. "Electric plug fittings." W. E. Evans and D. W. Dam. February 4th, 1920. (163,413.)

3,517. "Driving of dynamos." E. W. Scaumel and S. H. Van Abbott. February 5th, 1920. (163,414.)

3,750. "Railway signalling systems." A. E. Hudd, Automatic Telephone Manufacturing Co., Ltd. February 7th, 1920. (Cognate application 14,318/20.) (163,418.)

3,836. "Automatic fire-alarm systems." R. G. Evans and C. Thomas. February 7th, 1920. (163,419.)

3,889. "Time-limit relays, circuit breakers, or the like." A. Reyrolle & Co., Ltd., B. H. Leeson and J. Mirrey. February 9th, 1920. (163,420.)

4,104. "Means for supply of electric current to railway and like vehicles from the tracks." W. T. Jones. February 10th, 1920. (163,426.)

4,274. "Transmitters for wireless telegraphy and telephony." A. K. Macrorie, H. Morris-Airey and G. Shearing. February 11th, 1920. (163,118.)

4,454. "Wind-power electricity-generation plant." E. H. Jones and P. Burns. February 13th, 1920. (163,442.)

4,494. "Controlling devices for alternating electric current of variable frequency." British Thomson-Houston Co., Ltd., and H. W. Taylor. February 13th, 1920. (163,444.)

4,583. "Crystal detectors of electric currents." H. M. Dowsett. February 14th, 1920. (163,448.)

4,681. "Control of the excitation of dynamo-electric machines." British Thomson-Houston Co., Ltd., and F. H. Clough. February 16th, 1920. (163,454.)

4,739. "Valve transmitters for wireless telegraphy and telephony." A. K. Macrorie and G. Shearing. February 16th, 1920. (163,458.)

4,799. "Wireless communication." W. H. Eccles and J. H. Vincent. February 17th, 1920. (163,462.)

4,887. "Connectors for electric insulators." G. V. Twiss. February 17th, 1920. (163,467.)

5,007. "Electric incandescent lamps." F. Brighouse. February 19th, 1920. (163,478.)

5,033. "Electric ignition devices for lighting torches and the like." H. Schlaich. February 19th, 1919. (139,305.)

5,161. "Electric switches." H. D. Pyne. February 20th, 1920. (163,486.)

5,172. "Detection of high-frequency electric signalling currents." British Thomson-Houston Co., Ltd. (General Electric Co.). February 20th, 1920. (163,487.)

5,178. "Switch and means for locking same for use in connection with the ignition circuit of an internal-combustion engine and the like." W. Howlett. February 20th, 1920. (163,488.)

5,715. "Multi step thermionic amplifiers." M. I. Pupin. February 4th, 1918. (139,494.)

5,783. "Signalling apparatus for use in mine shafts." R. Blunt and H. F. Mitchell. February 26th, 1920. (162,850.)

6,347. "Magnetos." E. T. Férat. February 18th, 1918. (Addition to 139,781.) (139,782.)

7,020. "Electric heater." P. J. H. Bernard. March 8th, 1920. (163,525.)

7,176. "Electron-discharge devices." J. E. Lilienfeld. December 12th, 1919. (155,554.)

7,911. "Condensing steam electric locomotive." D. M. Ramsay and J. W. Wood. March 17th, 1920. (163,538.)

8,488. "Magneto-electric machine having a fixed permanent magnet and a fixed armature." L. N. Reddie (C. Olivette & Co.). March 22nd, 1920. (163,548.)

9,099. "Radio receiving systems." Western Electric Co., Ltd. January 5th, 1916. (141,040.)

9,223. "Signalling by high-frequency currents, as in wireless telephony." Western Electric Co., Ltd. May 18th, 1914. (141,047.)

9,337. "Electrical fuse holders." F. Shergold and A. H. Maxwell. March 31st, 1920. (163,562.)

13,053. "Electric switches and the like." T. Watson. May 11th, 1920. (163,590.)

14,268. "Machines for laying-up or twinning conductors for dry-core or other electric cables." W. T. Henley's Telegraph Works Co., Ltd., and H. Savage. May 25th, 1920. (163,594.)

16,403. "Telephone transmitters." Miessner Inventions Corporation. June 23rd, 1919. (146,105.)

17,530. "Rotary current distributors." J. A. Holm. June 28th, 1920. (163,609.)

18,686. "Sparking-tugs." A. L. Schmitz. July 5th, 1919. (146,824.)

18,691. "Electric controllers." Entz Motor Patents Corporation. July 18th, 1917. (146,829.)

18,831. "Starting and stopping devices for the electromotors of compressors, pumps, and so forth." J. Hulster. July 8th, 1914. (146,897.)

19,006. "Electric transforming apparatus for use with measuring-instruments." Compagnie pour La Fabrication des Compteurs et Matériel d'Usines a Gaz. May 8th, 1919. (147,048.)

19,228. "Automatic electric generating apparatus." Silent Valve Motors Corporation. September 15th, 1913. (147,166.)

19,937. "Manufacture of composite conductors for dynamo-electric machines and other electrical apparatus." Siemens-Schuckertwerke Ges. December 29th, 1917. (Addition to 147,571.) (147,885.)

20,045. "Interrupters for use in electric ignition systems." C. Rouquet. April 26th, 1919. (148,141.)

20,263. "Contact fingers for electric motor controllers." Constructions Electriques De Belgique (Soc. Anon.). March 18th, 1919. (148,345.)

22,369. "Electric motor starting device for internal-combustion engines." R. Bosch Akt.-Ges. September 22nd, 1919. (151,587.)

34,794. "Electric fuse fittings." A. N. Penman. December 9th, 1920. (163,652.)

1921.

668. "Polyphase transformer with switch-connected tapping points for changing the ratio of transformation." Bergmann-Elektricitats Werke Akt.-Ges. October 22nd, 1917. (156,672.)

5,614. "Electrically-heated muffle furnaces." Akt.-Ges Brown, Boveri et Cie. February 18th, 1920. (159,195.)

10,261. "Variable rheostats and the like devices." L. A. Gow. December 13th, 1919. (Divided application on 163,373.) (163,660.)